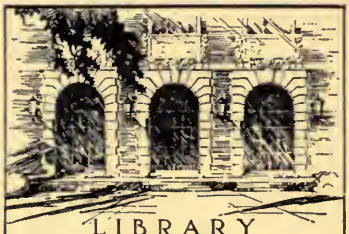

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Studies on the Keeping Quality of Butter in Cold Storage

By O. R. Overman
O. F. Garrett
H. A. Ruehe

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Urbana, Illinois September, 1938

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Studies on the Keeping Quality of Butter in Cold Storage

By O. R. Overman, O. F. Garrett, and H. A. Ruehe[a]

INTEREST in the changes which occur in butter during periods of storage has arisen with attempts to keep this product in large quantities from seasons of maximum to seasons of minimum production. Investigators have made many observations of the types of change that appear in butter during storage and of conditions which might be correlated with them. The influence of air, light, temperature of storage, acidity of the cream at time of churning, ferments and enzymes, salt, metals as catalytic oxidizing agents, and organic compounds as inhibitors of oxidation have all been studied.

The purpose of this investigation was to study butters of differing quality and from differently treated creams during extended periods of storage at customary storage temperatures, in order to determine the influence of various factors upon the keeping quality of butter, and especially to determine whether correlation exists between the keeping quality of butter and the results obtained by a laboratory examination of the fat.

REVIEW OF LITERATURE

Influence of Light and Air.—One of the early investigators, Patrick,[45*] found that butter showed evidence of deterioration at the end of five months' storage in a cellar where the temperature ranged from 46° to 66° F. Von Klecki[62*] observed that butter must be kept away from direct sunlight and at low temperature but that the activity of bacteria caused a greater increase in acidity than did sunlight and air. Fierz-David[12*] believed that rancidity was produced by air, light, and water without the action of bacteria; that unsaturated fatty acids were split into aldehydes and acids; and that fats containing saturated fatty acids were oxidized to the corresponding methyl alkyl ketones. Hanus[22*] said, "Under the influence of air and light the saponification equivalent and the acid number of the butterfat increased, the iodin number decreased, and the Reichert-Meissl number was not materially

[a]O. R. Overman, Associate Chief in Dairy Chemistry; O. F. Garrett, formerly First Assistant in Dairy Chemistry; and H. A. Ruehe, Chief in Dairy Manufactures.

*See literature citations, Pages 68-70.

changed." He noted that butter subjected to the action of air and light gradually lost its yellow color, became lardy in appearance, smelled very rancid and had a sharp, tallowy taste.

When Lidow[35*] subjected butter to artificial light, he observed a change in color from yellow to white, accompanied by the development of the taste and smell of tallow. Burr[5*] and Siegfeld[56*] found that butter and melted, filtered butterfat when exposed to light and air deteriorated in a short time, lost their aroma, became white like tallow, and assumed an unpleasant, tallowy taste and a pungent odor.

According to Reinmann,[49*] however, light is not of the importance in causing rancidity claimed by some investigators, and according to Jensen[28*] air is important only when accompanied by sunlight or high temperature. Nestrelayev[38*] found that butters from different parts of the country differed in their susceptibility to light and air, that the larger the content of unsaturated acid the greater the effect of light and air, and that the greatest changes produced by light and air were in the Koettstorfer number, the average molecular weight of the nonvolatile acids, and in the iodin absorption number.

Canzoneri and Bianchini[7*] studied the rancidity of olive oil and the oxidation of oleic acid in sunlight and air and found nonylic, azelaic, formic and dihydroxystearic acids among the products of the oxidation.

In experiments with dry and moist air Hyland and Lloyd[27*] found that complete oxidation is possible in dry air, whereas moist air prevented oxidation of glycerids and assisted oxidation of free fatty acids.

Salkowski[53*] considered that the development of rancidity in lard and butterfat was due to the combined activity of oxygen and light, and that it was a direct oxidation process in which the oxygen consumption could be measured. He believed that the speed of the reaction depended upon the intensity of the light and that little oxygen was consumed in the absence of light.

In a study of the causes and prevention of tallowiness in butter, Hunziker and Hosman[26*] concluded that tallowiness is the result of oxidation, exposure to air favors oxidation, and the action is intensified by light and heat.

Studies of Enzymes and Ferments.—Rogers[50*] found that deterioration of canned butter was due to an enzyme from milk or was produced in butter by microorganisms. On the other hand, Winckel,[65*] Thatcher and Dahlberg,[59*] Palmer and Combs,[43*] and Palmer and Miller[44*] concluded that enzymes and ferments had little, if any, effect upon the deterioration of butter in storage.

Effect of Salting.—Rahn, Brown, and Smith[48*] stated that salted butter kept better than unsalted butter above the freezing point as well as below, whereas Kildee[30*] found that unsalted butter kept better at 10°F. than did salted butter. Voss-Schrader,[63*] Buhl,[4*] Gray and McKay,[15*] and Sayer, Rahn, and Farrand[54*] observed that light salting had an advantage over heavy salting, and also that butters of high initial quality kept better than those of lower quality.

Effect of Acidity of Cream.—Anthor[1*] studied the development of rancidity in sweet- and sour-cream butter and found that sweet-cream butter became rancid much more slowly than did that made from sour cream. In an earlier experiment Patrick[45*] had found that the keeping quality of sweet-cream butter was better than that of the ripened-cream butter, altho there was no very marked difference between the two. Lucas, Ball, Vincent, and Trout[36*] observed that butter made from ripened cream deteriorated more rapidly during storage than sweet-cream butter.

White, Trimble, and Wilson[64*] found that butter made from cream of .15 to .25 percent acidity had deteriorated less after twelve months in storage than that made from cream of .28 to .31 percent acidity. Dyer[11*] found that the development of undesirable flavors in butter was directly proportional to the quantity of acids in the cream from which the butter was made. Stokoe,[57*] on the other hand, stated that the rancidity of pure fat is now generally understood to be due to a product of hydrolysis and oxidation and that acidity is in no way a measure of rancidity.

Oxidation Investigations.—According to Kerr and Sorber,[29*] the first indication of rancidity is the presence of loosely bound or labile oxygen.

Powick[47*] examined the degradation products of oleic acid by the use of the Kreis test and believes that epihydrin aldehyde is formed during the atmospheric oxidation of fats and suggests a trend of reactions producing this result. New[39*] advances a different trend of reactions but arrives at the same result.

Vincent[61*] concluded that when chemical changes occur in butter, the glycerids of the insoluble acids are altered to a greater degree than those of the soluble acids.

Browne[3*] kept butterfat in the laboratory in loosely stoppered bottles for twenty-eight years, subjecting the samples to occasional examination. He found a marked increase in the content of free and volatile acids and a considerable decrease in the content of insoluble acids. He advances the theory that the disintegration of the fats is

primarily due to the action of active or nascent oxygen, one atom of which is liberated for each atom absorbed at the points of unsaturation.

Much work has been done during the past few years on the autoxidation of fats, measurement of the susceptibility of fats to oxidation, and methods for retarding or inhibiting oxidation. Holm[16-19, 24, 25*] and his coworkers have devised means for measuring the length of the induction period and the susceptibility of butterfat to oxidation and have correlated these with the keeping quality of the butter.

Triebold,[60*] Coe,[8*] Coe and LeClerc,[9*] Royce,[51, 52*] Henderson and Roadhouse,[23*] and Lea[31*] have studied photochemical action as it influences the oxidation of fats. Wright and Overman[66*] observed that heat, copper, and lactic acid reduced the induction period, and that moisture did not retard the oxidation reaction. Others[26*] have found that copper alloys, as well as copper, and Fe_2O_3 are catalytic oxidizing agents; that the presence of lactose favors oxidation; and that overneutralization of cream accelerates oxidation. Garrett and Overman[14*] found that as the volume of oxygen absorbed by butterfat increased, the permanganate requirement of the fat decreased.

In their investigations Mattill and his coworkers,[10, 13, 37, 42*] Grettie,[20*] Greenbank and Holm,[17*] Shrewsbury and Kraybill,[55*] Caldwell and Bibbins,[6*] Olcott,[41*] and Lea[32, 33*] found that among the substances which were found to inhibit oxidation of butterfat are napthols, quinones, cephalin, glycin, asparagin, sodium citrate, sodium malonate, and certain unsaturated polybasic acids such as maleic.

OUTLINE OF INVESTIGATION

General Procedure

Thirty-six butters were studied from differently treated creams. They were taken directly from the churn and were packed in 3-pound paraffined, parchment-lined, Sealright cartons. Eleven to twelve cartons were filled from each churning except for Butter 28, which had only ten. The first sample of every lot was taken to the laboratory for immediate examination. This was the only sample subjected to the regular routine analysis to determine the percentages of water, fat, casein, ash, and salt.[a]

The remainder of the butter sample was melted over a steam-heated water bath and allowed to stand until the liquid fat had sep-

[a]Official and tentative methods of analysis of the Association of Official Agricultural Chemists, 1925.

arated in a clear layer. The fat was carefully decanted thru a folded filter paper into a liter bottle with a ground-glass stopper.

The other cartons of butter were placed in storage immediately after being packed and were kept at a temperature usually between 0° and -10° F. One carton of each butter was taken from storage at approximately regular intervals and the fat separated as described above. The usual time intervals between the removal of consecutive samples from storage were 6 weeks for the first six lots of butter, and 10 weeks for the remaining thirty lots.

Most of the butters were scored frequently by a competent judge.

Examination of Fat

The butterfat in every sample of each butter was examined in the laboratory as follows:

The index of refraction was determined with a Zeiss Butyro-refractometer. The readings were taken at about 45° C., reduced to correspond to 25° C. by formula (Leach,[34*] p. 93) and converted into indices of refraction by referring to the table giving such conversions (Leach,[34*] p. 91). The official Hanus method was used for the iodin absorption number. The saponification (Koettstorfer) number, the soluble acids, the insoluble acids (Hehner number), the free fatty acids, and the acetyl value were determined by the official methods. The method given in Leach[34*] (pp. 499-501) was used for the Reichert-Meissl, Polenske, and Jensen-Kirschner numbers, except that glass beads instead of pumice stone were used in the flasks from which the volatile acids were distilled. Hydrogen-ion concentration of the serum was determined using the quinhydrone method.

The mean molecular weights of the fats were computed by the formula:

$$\text{Mean molecular weight} = \frac{W \times 6{,}000}{3y}$$

in which W = weight of fat used and y = ml. of $N/2$ KOH used in the saponification (Bolton,[2*] p. 36).

The induction time and the volume of oxygen absorbed were measured, for the first six butters, by the method used by Wright and Overman.[66*] The apparatus used is shown in the photograph (Fig. 1) and in the detailed diagram (Fig. 2). Before Butter 7 was started, the apparatus was modified by the substitution of a gasometer constructed of sheet metal for the gas burette and a recording machine[a]

[a]Gasometer and recording machine built by J. B. Hayes, Urbana, Ill.

FIG. 1.—AUTOXIDATION APPARATUS

which automatically recorded elapsed time in minutes and the volume of oxygen absorbed at 110 ml. intervals. A DeKhotinsky constant temperature bath, in which transformer oil was the medium for transfer of heat, was used thruout the investigation. The oil was heated with Cenco knife-type units thermostatically controlled so that the temperature of the fat in the oxidation flask was maintained at 105-107° C. The oxidation flask was a 6-liter, tubulated, round-bottom pyrex flask. The larger opening was closed with a paraffined cork, thru which passed a motor-driven stirrer and a glass tube with a ground-glass stopcock to act as a vent. The cork in the smaller opening carried a thermometer which extended into the fat, an oxygen inlet tube,

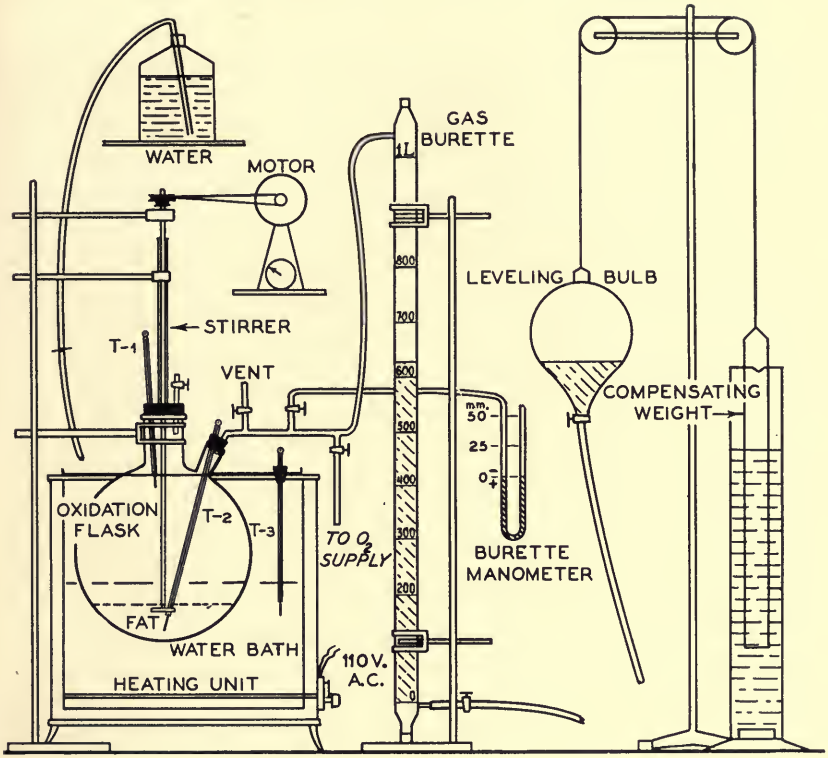

FIG. 2.—AUTOXIDATION APPARATUS

and a separatory funnel thru which the fat was introduced into the flask.

The stirrer was constructed of glass and wood and was made gas-tight by means of a mercury seal. The upper portion of the stirrer shaft extending thru the stopper was turned from a piece of straight-grained, well-seasoned birch. After turning, the wood was impregnated with hot paraffin. Into the lower end of the wood shaft was fitted a glass rod which extended almost to the bottom of the flask and carried two glass vanes at its lower end.

The operation of the oxidation experiments was started by bringing the bath to the desired temperature and replacing the air in the connecting tubes and the flask with oxygen from the gasometer which had been filled previously from a cylinder of compressed oxygen. Three hundred grams of the melted fat were introduced into the flask, the vent was closed and the stirrer run at such speed that the fat was

continuously splashed upon the sides of the flask. For the first six butters the induction period was taken as the time which elapsed from exposure of the fat to oxygen until the first visible evidence of oxygen absorption appeared upon observation of the gas burette. The experiments were continued until a considerable volume absorption had occurred, in many cases until the rate of absorption had become extremely slow. The volumes of oxygen absorbed and the elapsed time were read and recorded frequently during these experiments. The induction periods for Butters 7 to 36 could not be determined because the electrically operated recording device did not mark volume of oxygen absorbed until the first 110 ml. had been used. For that reason the initial period for these butters includes the induction time and the time necessary for the absorption of the first 110 ml. of oxygen.

History and Treatment of Creams

The treatment and churning data for the butters are given in Table 1. *Butters 1, 2, 3, and 6* were taken from four different churnings at the University of Illinois creamery. The history of these creams and the churning data were not obtained.

Butters 4 and 5 were obtained as follows: Raw cream testing 50.5 percent fat was separated from the mixed milk delivered by several patrons to the University creamery. The milk was from an evening milking and the following morning milking. The cream was standardized to 40 percent fat with some of the raw skimmed milk and was divided into two batches. The first batch (Butter 4) was pasteurized at 142° F. for 30 minutes, cooled, and standardized to 30 percent fat by adding pasteurized, cooled, skimmed milk obtained from the same skimming in which the cream was obtained. The acidity of the cream after pasteurizing, cooling, and standardizing was .11 percent. The cream was held overnight in a refrigerator at 40° F. or lower, and churned sweet.

The second batch of raw 40-percent cream (Butter 5) was standardized to 30 percent by adding raw skimmed milk obtained in the same skimming, and was cooled to 40° F. in ice water. The acidity after standardizing was .11 percent. The cream was held at temperatures ranging from 40° to 85° F. until it had become sour and had developed a disagreeable odor. At that time the acidity, having reached .68 percent, was reduced with magnesium lime suspension at 90° to 100° F. The cream was pasteurized at 142 to 145° F. for 30 minutes, cooled to 47° F., held overnight at 40° F. or lower, and churned in a 100-pound churn.

TABLE 1.—TREATMENT AND CHURNING DATA FOR BUTTERS 4 AND 5 AND 7 TO 33

Butter No.	Date of		Fat		Acidity				Starter	Neutralizer	Water added		Time of churning	Temperature of—			Salt	Pro-oxidant added ($CuSO_4$)	Antioxidant added (hydroquinone)
	Separation	Churning	When prepared	At churn	When prepared	Developed to—	Reduced to—	At churn						Cream	Buttermilk	Wash water			
			perct.	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*	*qt.*		*gal.*	*°F.*	*minutes*	*°F.*	*°F.*	*°F.*	*lb. per cwt. fat*	*perct.*	*perct.*
4[a]	6-19-29	6-20-29	40	30	.11	...	...	.12	None	None	..	...	27	52	...	51	3.5	.....	.....
5[b]	6-19-29	6-25-29	40	30	.11	.68	.20	.10	None	Magnesium lime	..	...	22	50	...	51	3.5	.....	.....
7	7-28-31	7-30-31	42.5	39.5	.13	.44	...	.44	3	None	1	46	16	45	58	45	3.2	.....	.....
8	7-28-31	7-30-31	42.5	39	.13	.61	...	.61	3	None	1	46	20	41	56	46	3.2	.....	.....
9	7-28-31	7-30-31	42.5	37.5	.13	.82	...	.82	3	None	1	48	23	38	52	48	3.2	.....	.....
10	7-28-31	7-30-31	42.5	38	.13	.60	.05	.44	3	Allwood lime	1	46	16	38	54	46	3.2	.....	.....
11	7-28-31	7-30-31	42.5	38.5	.13	.60	.20	.45	3	Allwood lime	1	46	27	37	54	46	3.2	.....	.....
12	7-28-31	7-30-31	42.5	38.5	.13	.60	.35	.45	3	Allwood lime	1	46	10	44	56	46	3.2	.....	.....
13	8-10-31	8-11-31	40.5	38.5	.11	...	...	.115	None	None	2	41	41	43	56	46	None	None	None
14	8-10-31	8-11-31	40.5	38.5	.11	...	...	.098	None	None	2	41	54	42	53	46	None	.25	None
15	8-10-31	8-11-31	40.5	38.5	.11	...	...	.11	None	None	2	50	43	42	56	48	None	None	.35
16	8-10-31	8-11-31	40.5	36	.11	...	...	.11	None	None	2	48	41	42	54	48	3.2	None	.35
17	8-10-31	8-14-31	40.5	36.5	.11	.57	.25	.25	3	Allwood lime	2	75	36	30	59	48	3.2	None	.175
18	8-10-31	8-14-31	40.5	36	.11	.57	.25	.25	None	Allwood lime	2	50	23	44	57	50	3.2	None	.175
19	8-24-31	8-25-31	41.5	37	.13	...	...	.13	None	None	3	80	38	32	56	48	3.2	.....	.....
20	8-24-31	8-26-31	41.5	38	.13	.87	.23	.23	None	Allwood lime	2	80	42	35	58	50	3.2	.....	.....
21	8-24-31	8-25-31	41.5	38	.13	...	...	.13	None	None	2	48	37	44	57	49	None	.....	.....
22	8-24-31	8-25-31	41.5	38	.13	...	...	.13	None	None	2	85	34	36	58	48	None	.....	.....
23	8-24-31	8-26-31	41.5	38	.13	.70	.25	.25	3	Allwood lime	2	87	30	35	56	50	None	.....	.....
24	8-24-31	8-26-31	41.5	38	.13	.87	.23	.25	None	Allwood lime	2	80	42	35	58	50	None	.....	.....
25	9-11-31	9-12-31	40	38	.11	...	...	.11	None	None	2	50	20	51	60	48	None	.....	.....
26	9-11-31	9-13-31	40	39	.11	.80	.24	.24	3	Allwood lime	2	60	28	42	60	48	None	.....	.....
27	9-11-31	9-13-31	40	38	.11	.80	.25	.25	None	Allwood lime	2	70	25	39	58	48	None	.....	.....
28	9-11-31	9-13-31	40	37.5	.11	.80	.23	.23	None	Calcium lime	2	70	25	39	60	48	None	.....	.....
29	9-11-31	9-13-31	40	38	.11	.80	.25	.25	None	Na_2CO_3	2	60	25	42	58	48	None	.....	.....
30	9-11-31	9-13-31	40	37.5	.11	.80	.22	.22	None	Na_2HCO_3	2	70	40	40	60	48	None	.....	.....
31	12- 4-31	12- 4-31	37	37	.12	...	...	.12	None	None	3	60	...	40	62	49	None	.....	.....
32	12- 4-31	12- 4-31	40.5	40.5	.125	...	...	.125	None	None	2	70	...	42	64	50	None	.....	.....
33	12- 4-31	12- 4-31	40	40	.125	...	...	.125	None	None	2	65	...	44	60	46	None	.....	.....

[a]Butters 4 and 5 were given 31 revolutions in working. All others were given 22 revolutions.
[b]The cream for Butter 5 was pasteurized 5 days after separation. All other creams were pasteurized the same day they were separated.

Butters 7 to 30 were made from four lots of cream, each of which was divided into six batches.

Lot 1: Butters 7 to 12. About 480 pounds of sweet cream (.13 percent acidity) testing 42.5 percent fat were pasteurized at 145 to 150° F. for 30 minutes. The cream was cooled, divided into six 80-pound batches, and each batch placed in a clean 10-gallon can. Following neutralization, the cream for Butters 10, 11, and 12 was cooled over brine coils and held in a refrigerator at 40° F.

For all butters from No. 7 to No. 33 the washing was uniform—first, 5 gallons of water for six turns of the churn, followed by 10 gallons for ten turns.

Lot 2: Butters 13 to 18. About 475 pounds of sweet cream (.11 percent acidity) testing 40.5 percent fat were pasteurized at 146° F. for 30 minutes. The cream was cooled, divided into six equal batches and stored in clean 10-gallon cans. Batches 13, 14, 15, and 16 were chilled to 52° F. over brine coils and stored in a refrigerator to be churned as sweet cream. Batches 17 and 18 were cooled to 75° F. and stored at ordinary room temperature. Three quarts of starter were added to Batch 17 while Batch 18 was allowed to sour spontaneously.

The copper sulfate was added to Butter 14 by sprinkling a sufficient amount of a concentrated water solution over the butter in the churn previous to working. Hydroquinone was added to Butter 15 by scattering the dry compound over the butter and then working it into the butter. For Butters 16, 17, and 18 the dry hydroquinone was mixed with the salt and the mixture worked into the butter in the churn.

Lot 3: Butters 19 to 24. Four hundred sixty-nine pounds of sweet cream (.13 percent acidity) testing 41.5 percent fat were pasteurized at 145° F. and divided into six equal parts. Nos. 19, 21, and 22 were cooled over brine coils to 50° F. and stored to be churned as sweet cream. Nos. 20, 23, and 24 were cooled to 75° F. and kept at room temperature. Nos. 20 and 24 were allowed to sour spontaneously, while starter was added to No. 23.

The butters from Nos. 22, 23, and 24 were melted, the fat separated from the serum, and the liquid fat was filtered. The filtered fats were stored in paraffined cartons in the same manner as the butters were stored and were subjected to the same examination in the laboratory.

Lot 4: Butters 25 to 30. Four hundred thirty-nine pounds of sweet cream (.11 percent acidity) testing 40 percent fat were pasteurized at 145° F. for 30 minutes and divided into six equal parts. No. 25 was cooled and stored for churning while sweet. Starter

was added to No. 26. Nos. 27, 28, 29, and 30 were allowed to sour spontaneously at room temperature. Yeastiness developed in these four creams.

Butter 31 was made from cream separated from the mixed milk of Holstein cows in the University of Illinois dairy herd. Ninety-seven pounds of cream of .12 percent acidity and 37 percent fat were used.

Butter 32 was made from cream separated from the mixed milk of Guernsey cows in the University dairy herd. Ninety-six pounds of cream of .125 percent acidity and 40.5 percent fat were used.

Butter 33 was made from cream separated from the mixed milk of the University herd. Ayrshire, Brown Swiss, Guernsey, Holstein, and Jersey milk were all present in this mixture. Eighty-nine pounds of cream of .125 percent acidity and 40 percent fat were used.

These three creams (Nos. 31, 32, and 33) were pasteurized at 145° F. for 30 minutes, then cooled and churned while sweet.

Butters 34, 35, and 36 were obtained from churns at local creameries. The history of the creams from which these butters were made and the treatment and churning data were not obtained.

EXPERIMENTAL RESULTS

The results of analysis of the butters for percentages of water, fat, casein, ash, and salt are given in Table 2 (page 71).

The date of examination, the score of the butter, and the data obtained in the examination of the fats are shown in Table 3 (pages 72-85). The acetyl value and the pH of the serum were not determined for Butters 1 to 6.

Acidity of Cream

All the butter scores showed the usual trend during storage. The butters churned from sweet cream scored higher and held up better in score during storage than those churned from the same cream after ripening with starter and reduction of the acidity. Those from ripened cream scored higher and held up better in storage than those made from the same cream after it was allowed to sour spontaneously and then reduced in acidity to approximately the same value as the ripened cream after neutralization.

Butter from cream ripened with starter to .44 percent acidity scored higher and kept better in storage than did that from the same cream ripened to .61 percent acidity and churned without reduction

of the acidity, and the latter in turn showed similar advantages over butter from cream ripened with starter to .82 percent acidity and churned at that acidity.

Salting

Butters churned from sweet cream and salted showed only slight differences in initial score and keeping quality from those churned from sweet cream and not salted. These slight differences were in favor of the unsalted butter.

The butters with highest initial scores were No. 31 churned from sweet cream separated from fresh Holstein milk, No. 32 from sweet cream separated from fresh Guernsey milk, and No. 33 from sweet cream separated from fresh mixed milk from the University of Illinois dairy herd. These three butters were not salted. Their initial scores were respectively 93.5, 94.0, and 93.5. These three butters scored 90 to 91 after 18 to 20 months in storage and were still salable butters after 23 to 25 months.

Index of Refraction

No relation seems to exist between the index of refraction and the initial quality or the keeping of butter in storage. However, those butters made in December gave appreciably lower indices of refraction than did those made during May to September.

Iodin Absorption

The iodin absorption number showed no correlation with keeping quality altho it appeared to be dependent upon the season of the year in which the butters were made. Butters 1 to 30, which were made during the months of May to September gave, for the fresh butter, iodin absorption numbers ranging from 36.00 to 41.80, while Butters 31 to 36, which were made in December, gave, for the fresh butter, numbers ranging from 30.24 to 33.16.

None of the other chemical values determined appear to bear any discoverable relation to the keeping quality of the butters or to the time of year in which the butter was made.

Oxidation

Following the exposure of a butterfat to an atmosphere of oxygen at a temperature of 105° to 107° C. the first evidence of change was observed in the color of the fat. After some time, the length of which varied greatly with different butterfats, the yellow color of the fat

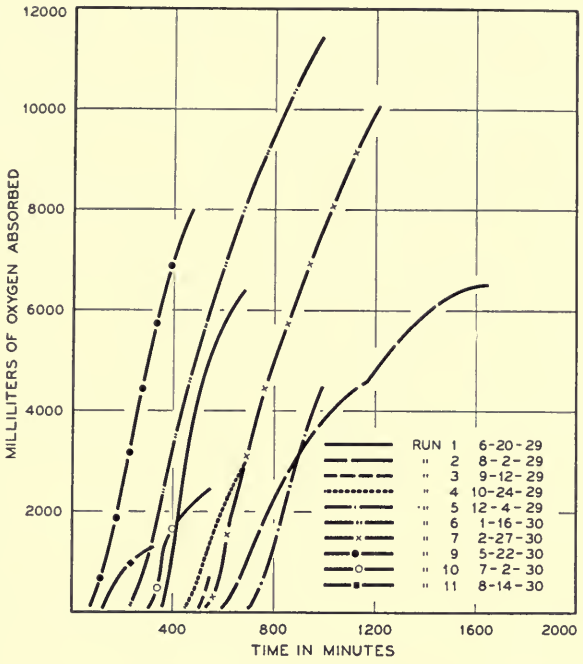

FIG. 3.—TREND OF OXYGEN ABSORPTION FOR BUTTER 4

Butter 4 was churned from sweet cream. The results shown in Figs. 3 and 4 were obtained with the original form of absorption apparatus.

began to fade. The fading continued rather rapidly until the color became a very light straw-yellow, and in many cases the fat became almost completely colorless. At this point the fat had the appearance of melted lard or tallow and had developed a very distinct tallowy odor and taste. Very soon after the discharge of the color, absorption of a readable volume of oxygen became evident. However, the color of the fat in some samples of Butters 15 to 18, which contained an anti-oxidant (hydroquinone), did not fade even on exposure of the fat to oxygen for 50 to 70 hours.

The length of time which elapsed from initial exposure of the fat to oxygen until the beginning of apparent volume absorption by Butters 1 to 6, or until 110 ml. of oxygen had been used for Butters 7 to 36, varied greatly for different butters and even for samples of the same butter after different lengths of storage time.

No consistent relation between the initial quality of the butter or the time in storage and the induction period (or the induction period increased by the time required for absorption of the first 110 ml.

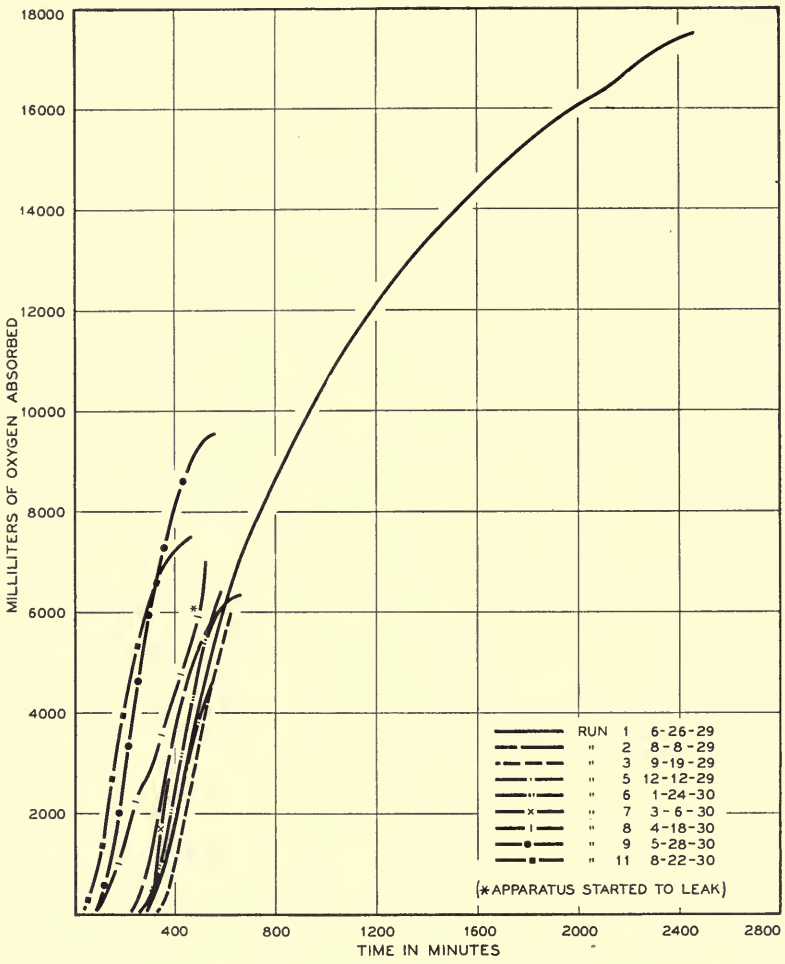

FIG. 4.—TREND OF OXYGEN ABSORPTION FOR BUTTER 5

A portion of the same lot of cream used for Butter 4 was allowed to sour spontaneously to .68 percent acidity. The acidity was then reduced to .20 percent with magnesium lime.

of oxygen) could be observed. It is true that for some butters this time interval was shorter after many months in storage, but for other butters it was not shorter, and in some cases was even longer. Butter 14, to which .25 percent of $CuSO_4$ had been added, showed a much shorter time interval than did any of the other butters, while for Butters 15 to 18 the intervals were somewhat longer for most samples, but were very irregular in length.

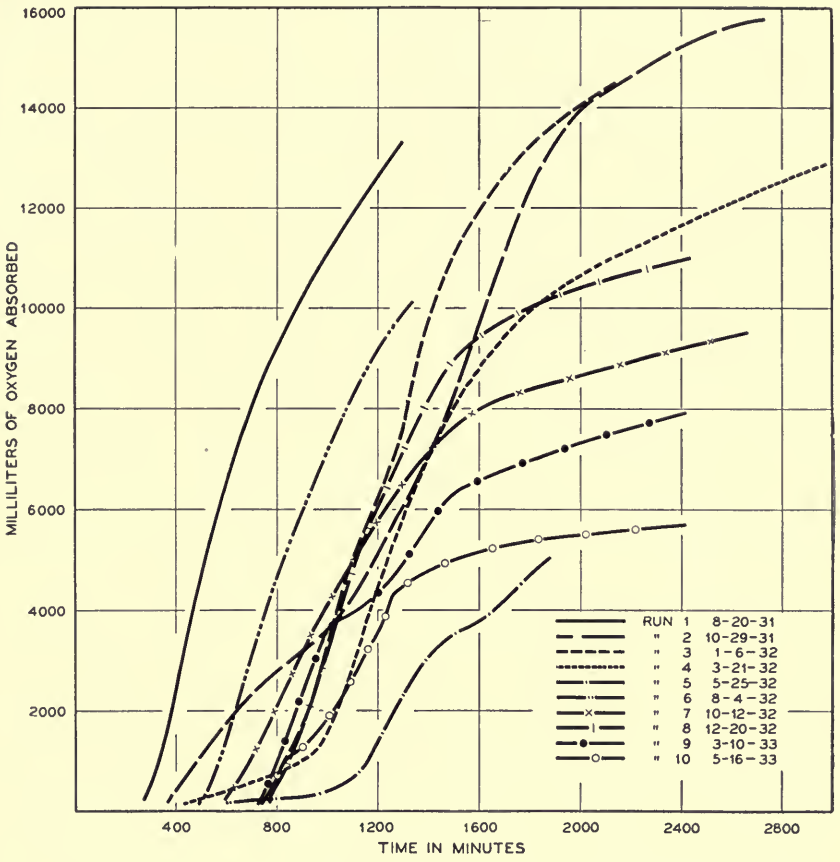

FIG. 5.—TREND OF OXYGEN ABSORPTION FOR BUTTER 13
Butter 13 was churned from sweet cream.

The rates of absorption of oxygen by the butterfat samples (Table 4, pages 86-90) were also very irregular and appeared to bear no definite relation to the quality of the butter nor to the length of time it was in storage. Absorption started rather slowly and proceeded at an increasing rate for a short time, the rapidity varying greatly with the butter used. The rate soon became constant and continued so during the absorption of the major portion of the volume of oxygen absorbed. The rate then decreased until it finally reached zero. However, in Butters 15 to 18, which contained hydroquinone, the absorption started slowly and maintained very nearly the same rate thruout the absorption period, except near the end, when it became

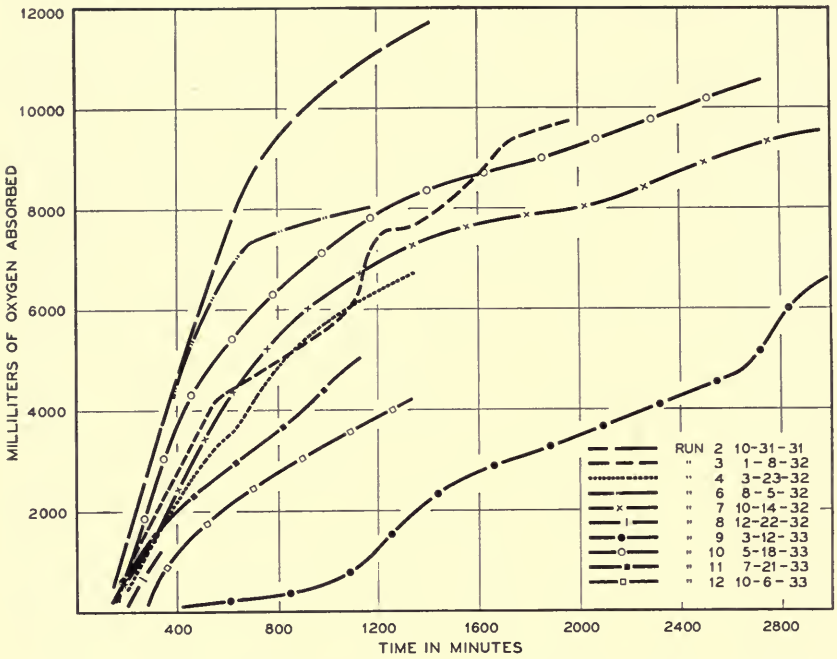

FIG. 6.—TREND OF OXYGEN ABSORPTION FOR BUTTER 14

Butter 14 was from the same lot of cream as No. 13, but a prooxidant ($CuSO_4$) was worked into the butter.

exceedingly slow and finally ceased entirely. For these butters the rates of absorption, as well as the total volume of oxygen absorbed, were decidedly less than for the other butters.

The trend of oxygen absorption for a few of the butters studied during these investigations is indicated in Figs. 3 to 9. These graphs show the results obtained with some of the butters most widely different in quality. It will be noted that the oxidation record is not given for every sample of the butter. For various reasons runs were not made for a few of the samples or, because of laboratory difficulties, were discontinued.

The curves for Butters 4 and 5 show the initial period extending from the first exposure to oxygen until the beginning of absorption. For Butters 13, 14, 15, 27, and 32, the initial period extended from first exposure until 110 ml. of oxygen had been absorbed. The curves extend over the period of increasing rate of absorption and part or all of the period of constant rate of absorption (represented by the

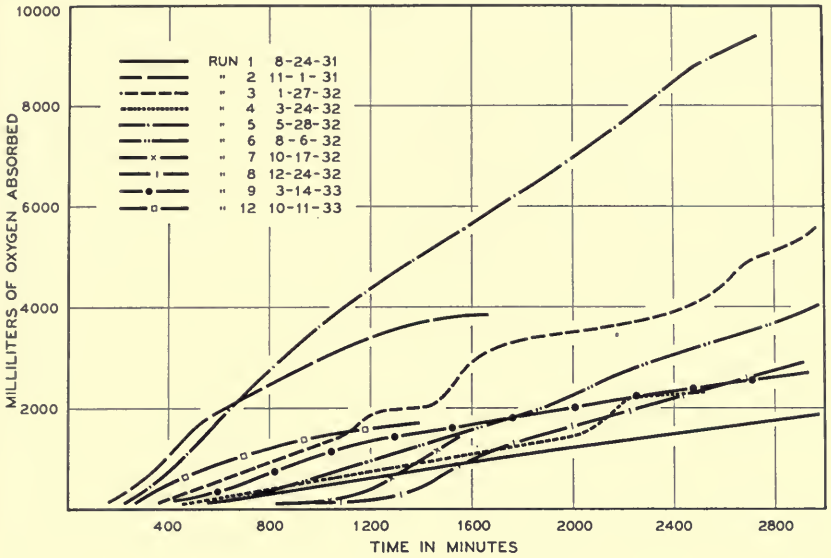

FIG. 7.—TREND OF OXYGEN ABSORPTION FOR BUTTER 15

Butter 15 was from the same lot of cream as Nos. 13 and 14, but an antioxidant (hydroquinone) was worked into the butter.

rectilinear portions of the curves). For those samples which were left in contact with the oxygen for sufficient time, the period of decreasing rate of absorption is shown. A few of the curves enter the final period of no absorption of oxygen.

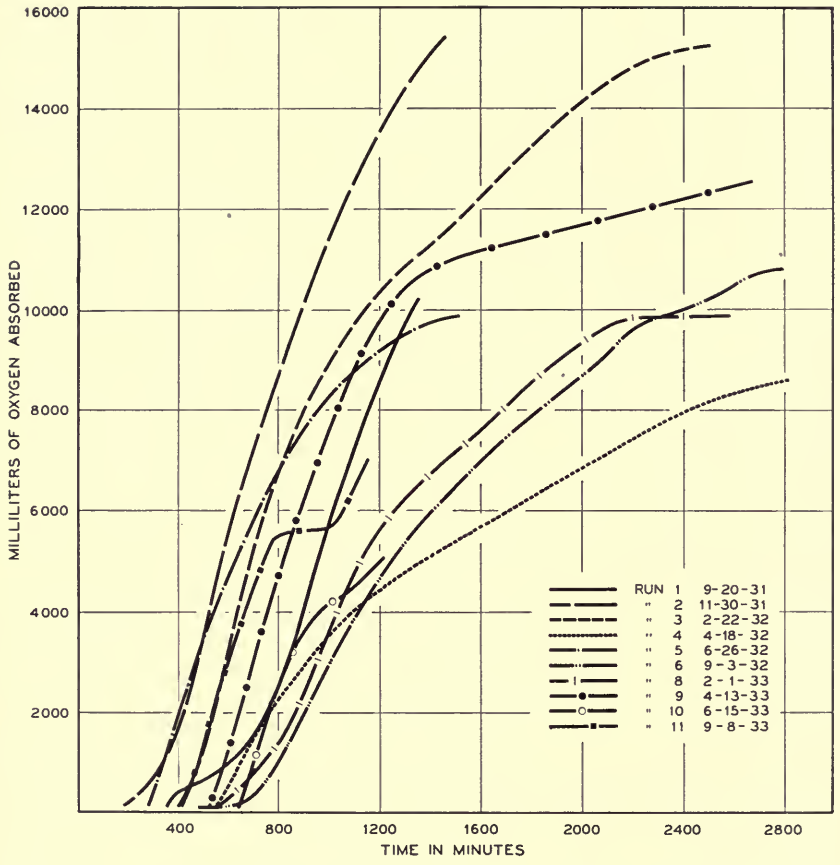

FIG. 8.—TREND OF OXYGEN ABSORPTION FOR BUTTER 27

This was one of the poorest butters studied. The cream was allowed to sour spontaneously to .80 percent acidity. The acidity was then reduced to .25 percent.

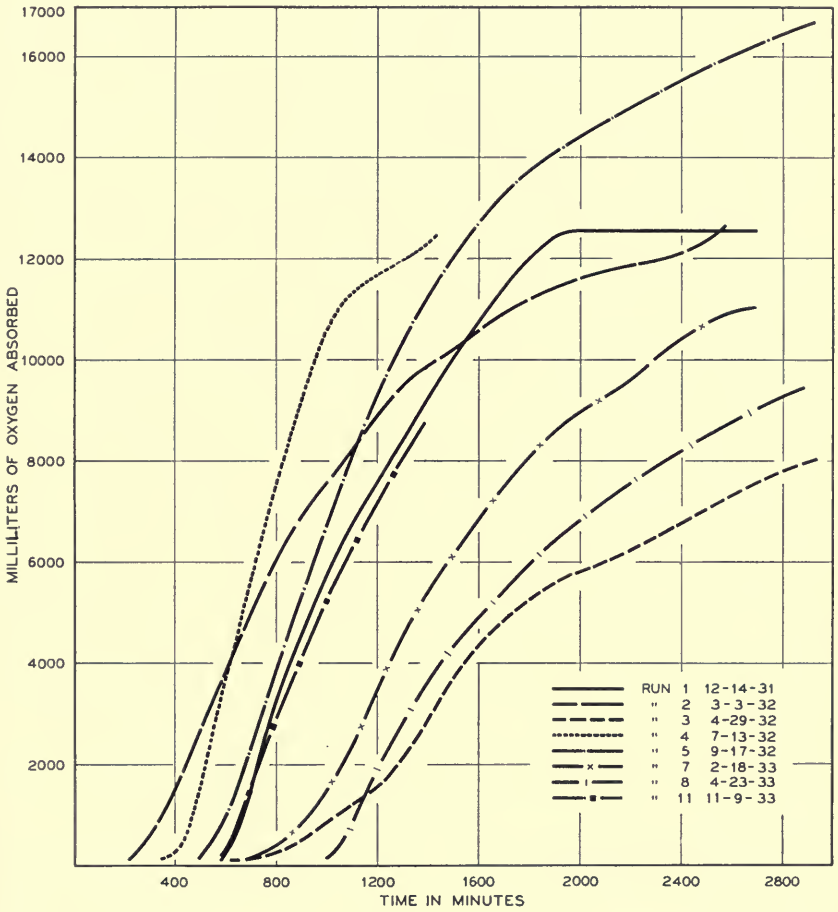

FIG. 9.—TREND OF OXYGEN ABSORPTION FOR BUTTER 32

This was one of the best butters studied. It was churned from fresh, sweet cream separated from fresh milk. The time from milking until the butter was made was only that required for transporting the milk from barns to creamery, separation, pasteurization, cooling, and churning.

SUMMARY AND CONCLUSIONS

Thirty-six butters ranging in quality from very poor to very good were studied in an attempt to determine the influence of various factors upon the keeping quality of butter held at customary storage temperatures. The experiment extended over a period of five years. A special effort was made to determine whether there was any relation between the keeping quality of butter and the results obtained by a laboratory examination of the fat. The butters were scored and the first sample of each lot was analyzed for water, fat, casein, ash, and salt. The butterfat was separated from every sample of all the butters and was subjected to laboratory examination and to oxidation in an atmosphere of oxygen at 105° to 107° C. From these investigations the following conclusions and observations were made:

1. The judge's score of a butter, altho a statement of quality at the time of scoring, does not give any indication of its keeping quality.

2. The particular chemical and physical constants determined do not show correlation with keeping quality.

3. The induction periods and the rates of oxidation vary so irregularly that there is no evidence of any relation of these to keeping quality.

4. Butter made from sweet cream scored higher and held its score better in storage than butter made from the same cream after ripening with starter and partial neutralization, and the latter was correspondingly better than butter made from the same cream after spontaneous souring and neutralization to the same percentage of acidity.

5. Different neutralizers used to reduce the acidity of separate lots of the same cream to approximately the same percentage of acidity did not affect the initial score or the keeping in storage.

6. Butter from cream ripened with starter to .44 percent acidity and churned without neutralization scored higher and held its score better in storage than did butter from the same cream after it was ripened with starter to .61 percent acidity and churned without neutralization. The latter was correspondingly better than butter churned from the same cream without neutralization after ripening with starter to .82 percent acidity.

7. Overneutralization of cream produced a butter with low initial score and poor keeping quality.

8. Butter churned from sweet cream and salted scored slightly higher but lost score more rapidly than unsalted butter from the same cream.

9. The butters which were given the highest initial scores and held their scores best of all those studied in these investigations were churned from fresh sweet cream separated from fresh sweet whole milk. These butters (Nos. 31, 32, and 33) were not salted and were of salable quality after about two years in storage.

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Tables 2 to 4

TABLE 2.—ANALYSES OF BUTTER SAMPLES[a]

Sample No.	Water	Fat	Casein	Ash	Salt
	perct.	*perct.*	*perct.*	*perct.*	*perct.*
1	15.80	80.86	1.01	2.35	1.47
2	16.54	80.06	.86	2.54	1.32
3	15.22	81.79	1.04	1.96	1.18
4	14.79	83.12	.89	1.20	.71
5	15.69	81.54	.76	2.01	.99
6	14.24	83.14	.78	1.85	1.08
7	15.58	82.90	1.12	.41	.34
8	15.09	83.20	.99	.72	.68
9	15.01	83.33	1.08	.58	.57
10	11.45	87.25	.73	.64	.57
11	13.42	85.37	.66	.61	.61
12	13.24	84.84	.91	1.00	.93
13	13.97	84.56	1.17	.05	0
14	12.98	86.07	.92	.04	0
15	13.91	84.32	1.73	.04	0
16	12.73	85.81	.77	.69	.60
17	14.86	83.48	.80	.85	.73
18	13.41	84.71	1.21	.67	.59
19	12.53	85.73	.71	1.03	.78
20	13.04	85.05	.88	1.11	.87
21	15.09	84.37	.46	.06	0
25	14.31	85.02	.63	.04	0
26	14.04	85.42	.50	.05	0
27	13.84	85.62	.47	.07	0
28	14.52	84.97	.50	.01	0
29	12.39	87.22	.38	.01	0
30	13.93	85.69	.37	.01	0
31	15.10	84.26	.56	.08	0
32	16.39	83.03	.53	.06	0
33	15.21	84.11	.62	.06	0
34	13.72	83.13	.74	2.40	2.05
35	16.42	80.44	.97	2.17	1.96
36	16 13	81.22	.98	1.67	1.47

[a]These analyses were not made for samples of Butters 22, 23, and 24.

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS OF THIRTY-SIX BUTTERS
(Butters 1 to 6)

	Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Mean molecular weight of fat
						BUTTER 1						
(1)	5-23-29....	92	1.46035	37.58	230.58	3.58	85.90	29.01	2.66	22.57	.45	243.32
(2)	7- 5-29....	90	1.46072	39.48	228.28	4.02	86.37	28.63	2.59	21.84	.42	245.78
(3)	8-15-29....	88.5	1.46037	37.30	231.00	5.06	85.45	27.00	2.56	21.85	.46	242.88
(4)	9-26-29....	89	1.46033	37.94	230.40	5.55	84.24	29.56	2.54	22.32	.33	243.50
(5)	11- 7-29....	90	1.45992	37.89	230.32	4.75	87.28	30.85	2.61	25.58	.30	243.60
(6)	12-19-29....	90	1.46048	36.50	229.64	5.14	87.21	30.46	2.69	25.04	.33	244.30
(7)	1-30-30....	90	1.46005	37.12	228.40	3.92	87.86	30.30	2.60	24.66	.31	245.64
(8)	3-13-30....	90	1.46081	37.08	226.58	4.61	86.94	30.78	2.71	25.96	.31	247.61
(9)	4-24-30....	90	1.46025	36.74	227.00	4.32	86.39	29.47	3.36	26.18	.28	247.16
(10)	6- 5-30....	90	1.45972	35.99	229.02	5.04	87.62	28.65	2.53	23.84	.28	244.96
(11)	7-17-30....	88	1.46042	38.61	225.71	4.51	86.00	26.75	3.09	25.66	.28	248.60
						BUTTER 2						
(1)	6- 6-29....	91	1.45996	39.08	231.62	4.19	84.46	30.08	2.92	25.61	.46	242.22
(2)	7-18-29....	90	1.45998	41.14	228.68	5.26	86.64	28.44	2.40	23.00	.47	245.34
(3)	8-28-29....	89.5	1.46049	37.70	232.04	5.89	86.92	29.18	2.08	23.65	.45	241.80
(4)	10-10-29....	89	1.46027	37.80	230.82	5.18	85.42	31.46	2.93	26.45	.43	243.08
(5)	11-21-29....	88	1.46037	37.10	230.29	4.76	88.30	30.80	2.72	25.90	.36	243.63
(6)	1- 2-30....	88	1.46035	37.24	230.38	4.53	87.34	30.52	2.40	23.26	.42	243.53
(7)	2-13-30....	88.5	1.46032	37.02	228.52	4.62	86.94	31.17	2.54	26.34	.38	245.46
(8)	3-27-30....	89	1.46028	36.24	229.75	4.24	87.70	31.09	2.70	24.36	.41	244.20
(9)	5- 8-30....	90	1.46058	35.48	228.78	3.96	87.66	30.02	2.96	25.64	.45	245.22
(10)	6-19-30....	89	1.46020	36.06	229.77	4.96	87.01	29.68	2.60	25.84	.39	244.18
(11)	7-30-30....	89	1.46051	39.23	230.38	3.65	87.03	29.38	2.20	25.32	.41	243.54
						BUTTER 3						
(1)	6-14-29....	90.5	1.46008	36.00	234.18	4.78	86.01	30.64	3.46	26.12	.38	239.58
(2)	7-25-29....	90	1.46011	42.57	228.38	4.59	85.92	30.36	2.40	24.47	.42	245.66
(3)	9- 5-29....	90.5	1.46018	37.30	232.04	4.69	85.80	30.62	2.58	21.89	.42	241.78
(4)	10-17-29....	90	1.45980	37.41	231.14	5.72	85.52	31.72	3.06	26.52	.39	242.74
(5)	11-27-29....	90	1.46045	37.61	231.73	4.90	87.02	33.02	2.97	24.90	.48	242.11
(6)	1- 9-30....	90	1.46016	37.02	233.20	3.78	87.88	31.30	2.68	25.36	.40	240.58
(7)	2-20-30....	90	1.46034	37.32	230.83	4.70	86.99	31.81	2.63	26.86	.34	243.06
(8)	4- 3-30....	89	1.46010	36.68	229.68	4.95	87.70	31.58	2.92	25.86	.34	244.26
(9)	5-15-30....	88.5	1.46020	36.17	230.08	4.80	87.90	30.42	2.94	26.26	.36	243.86
(10)	6-26-30....	88.5	1.45991	36.01	229.62	4.89	86.14	30.54	3.06	26.08	.36	244.34
(11)	8- 6-30....	88	1.46017	37.58	230.35	3.96	84.20	30.13	2.04	24.87	.49	243.56
						BUTTER 4						
(1)	6-21-29....	93.5	1.46043	40.04	231.00	4.38	85.48	29.49	2.66	27.26	.28	242.88
(2)	8- 1-29....	92	1.46035	40.51	228.58	3.80	85.14	23.80	2.31	18.11	.30	245.44
(3)	9-12-29....	92	1.46075	39.18	228.44	5.36	82.81	26.48	2.48	19.58	.25	245.60
(4)	10-24-29....	90	1.46060	39.86	229.78	5.17	85.48	30.34	2.42	24.84	.44	244.17
(5)	12- 4-29....	91	1.46002	40.10	230.27	4.23	82.06	30.85	2.76	24.62	.27	243.64
(6)	1-16-30....	90	1.46019	38.06	229.22	4.47	88.00	30.30	2.40	25.66	.45	244.76
(7)	2-27-30....	89.5	1.46057	37.75	228.25	4.56	87.24	30.41	2.72	25.26	.21	245.80
(8)	4-10-30....	89	1.46038	39.08	227.82	5.07	86.22	31.82	2.70	26.56	.24	246.26
(9)	5-22-30....	89	1.46062	38.06	227.32	4.30	87.30	30.46	2.99	24.81	.27	246.81
(10)	7- 2-30....	88.5	1.45990	40.54	225.10	3.96	86.72	30.22	3.16	25.56	.21	249.24
(11)	8-13-30....	89	1.46072	40.42	224.31	4.12	88.10	29.09	2.31	23.68	.27	250.12
						BUTTER 5						
(1)	6-25-29....	88	1.46095	40.12	229.40	4.26	86.30	26.46	2.60	22.98	.44	244.57
(2)	8- 8-29....	88	1.46050	40.06	228.52	5.81	87.60	28.84	2.58	24.65	.39	245.52
(3)	9-19-29....	87	1.46093	39.74	228.12	5.16	85.61	29.38	2.58	24.48	.32	245.94
(4)	10-31-29....	88	1.46058	39.96	233.34	5.04	86.23	29.88	2.40	25.29	.30	240.44
(5)	12-12-29....	89.5	1.46065	39.37	230.42	4.36	87.30	31.20	2.79	25.45	.34	243.49
(6)	1-23-30....	86.5	1.46052	39.87	229.42	4.30	88.59	30.16	2.44	.....	.32	244.55
(7)	3- 6-30....	87.5	1.46066	39.12	229.00	4.85	88.42	30.47	2.70	26.16	.30	245.00
(8)	4-17-30....	87	1.46039	37.72	227.63	....	87.32	29.43	3.21	22.91	.31	246.48
(9)	5-28-30....	87	1.46051	38.50	226.99	4.06	88.24	29.30	2.83	25.97	.30	247.16
(10)	7- 8-30....	86.5	1.45958	41.28	225.73	4.44	.....	30.16	3.10	26.11	.31	248.54
(11)	8-21-30....	86.5	1.46072	40.50	225.68	4.49	87.03	29.41	2.17	22.46	.27	248.60
						BUTTER 6						
(1)	7-13-29....	90	1.46057	41.80	228.88	5.65	88.18	28.67	1.86	21.82	.56	245.12
(2)	8-22-29....	90	1.46051	38.60	227.48	4.54	86.46	28.02	2.17	19.09	.52	246.63
(3)	10- 3-29....	90	1.46066	40.22	228.92	5.09	87.56	31.46	2.47	26.02	.50	245.09
(4)	11-14-29....	89	1.46035	40.02	229.88	4.76	87.92	29.25	2.32	24.58	.46	244.06
(5)	12-26-29....	90.5	1.46068	39.72	228.56	4.64	87.81	30.10	2.20	25.04	.48	245.48
(6)	2- 6-30....	88	1.46050	35.46	229.02	4.46	.....	29.52	2.02	24.67	.42	244.96
(7)	3-20-30....	87.5	1.46039	39.98	227.53	4.72	87.81	29.76	2.60	25.38	.42	246.58
(8)	4-30-30....	88	1.46034	39.20	226.10	4.24	86.64	26.50	3.70	26.26	.45	248.14
(9)	6-12-30....	88.5	1.46054	38.48	225.82	4.75	87.38	29.24	2.19	25.48	.47	248.45
(10)	7-24-30....	88.5	1.46051	40.65	226.60	3.88	85.93	26.12	2.00	24.36	.38	247.65
(11)	8-28-30....	88	1.46045	41.37	226.52	4.24	88.52	27.71	2.04	20.76	.44	247.68

TABLE 3B.—OXIDATION DATA FOR THIRTY-SIX BUTTERS (Butters 1 to 6)

	Induction period, minutes	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated											Total milliliters of O_2 absorbed	Time for total O_2 absorbed, minutes
		500	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000		
							BUTTER 1							
(1)	250	314	345	401	461	523	...	...	...	...	...	...	4700	572
(2)	435	496	515	568	636	703	783	...	...	...	...	...	5600	848
(3)	414	472	488	534	574	621	670	726	...	...	...	...	6500	763
(4)	360	408	433	480	525	577	...	...	...	...	...	...	4400	595
(5)	294	357	385	430	513	...	...	...	...	...	...	...	3500	587
(6)	300	341	370	427	473	522	576	651	...	...	...	...	6200	671
(7)	620	691	725	782	837	...	...	...	...	...	...	...	3000	837
(8)	415	490	532	608	677	757	...	...	...	...	...	...	4100	765
(9)	...	...	...	...	...	...	...	...	...	...	...	...	....	...
(10)	250	285	307	328	...	...	...	...	...	...	...	...	2900	364
(11)	84	114	141	211	307	...	...	...	...	...	...	...	3100	315
							BUTTER 2							
(1)	85	137	166	218	269	328	397	476	...	...	...	...	6300	510
(2)	495	556	594	648	699	759	860	...	...	...	...	...	5000	860
(3)	198	241	261	295	329	365	403	439	485	536	593	665	11300	780
(4)	310	375	405	455	500	543	602	...	...	...	...	...	5500	640
(5)	260	325	353	420	482	548	623	...	...	...	...	...	5175	643
(6)	385	465	499	558	625	707	810	...	...	...	...	...	5450	860
(7)	475	540	580	646	...	...	...	...	...	...	...	...	2000	646
(8)	150	200	227	271	314	356	411	469	532	606	...	...	8300	637
(9)	190	250	286	350	421	504	...	...	...	...	...	...	4500	553
(10)	50	105	153	264	...	...	...	...	...	...	...	...	2350	439
(11)	40	85	117	193	...	...	...	...	...	...	...	...	2930	345
							BUTTER 3							
(1)	475	534	563	612	662	715	779	862	960	...	...	...	7000	960
(2)	415	514	544	600	656	710	767	...	...	...	...	...	5000	767
(3)	225	253	275	319	361	414	468	531	601	675	...	...	8600	780
(4)	442	501	531	...	...	...	...	...	...	...	...	...	1900	586
(5)	300	394	437	517	606	...	...	...	...	...	...	...	3000	606
(6)	270	330	352	400	458	529	610	...	...	...	...	...	5000	610
(7)	230	291	325	380	441	522	606	...	...	...	...	...	5000	606
(8)	215	277	310	361	411	475	...	...	...	...	...	...	4400	512
(9)	140	196	235	295	357	417	...	...	...	...	...	...	4500	461
(10)	140	169	185	254	296	351	...	...	...	...	...	...	4850	505
(11)	90	190	...	...	...	...	...	...	...	...	...	...	500	190
							BUTTER 4							
(1)	335	368	385	416	447	487	539	619	...	...	...	...	6400	677
(2)	570	645	685	773	877	1031	1217	1404	...	...	...	...	6425	1636
(3)	484	530	...	...	...	...	...	...	...	...	...	...	700	541
(4)	430	480	506	579	685	...	...	...	...	...	...	...	3000	685
(5)	680	740	776	833	886	948	...	...	...	...	...	...	4500	990
(6)	205	264	292	340	380	429	478	536	606	674	755	841	11400	976
(7)	520	573	595	631	685	734	808	884	951	1028	1108	1198	10100	1228
(8)	295	353	...	...	...	...	...	...	...	...	...	...	800	388
(9)	70	88	124	173	208	252	298	343	396	470	...	...	8000	470
(10)	295	330	355	440	...	...	...	...	...	...	...	...	2450	547
(11)	110	157	220	Continued until 460 min. but no absorption beyond 1300									1300	325
							BUTTER 5							
(1)	276	328	354	402	443	484	530	586	643	721	820	921	17500	2509
(2)	215	258	281	322	366	415	471	573	...	...	...	...	6350	660
(3)	320	369	392	433	475	517	565	618	...	...	...	...	6000	618
(4)	535	...	...	...	...	...	...	...	...	...	...	...	4200	820
(5)	245	329	358	410	456	507	569	...	...	...	...	...	5000	569
(6)	240	312	335	373	411	453	504	557	...	...	...	...	6400	579
(7)	250	304	322	345	...	...	...	...	...	...	...	...	2700	372
(8)	70	132	169	232	311	369	435	492	518	545	...	...	8900	567
(9)	85	114	137	169	198	228	260	293	336	384	455	...	9550	555
(10)	50	113	243	...	...	...	...	...	...	...	...	...	1100	260
(11)	30	68	89	119	149	185	231	281	353	...	...	...	7500	450
							BUTTER 6							
(1)	283	320	...	...	...	...	...	...	...	...	...	...	900	341
(2)	275	323	344	378	409	432	463	503	552	606	668	752	10700	827
(3)	175	213	236	277	310	355	403	463	537	653	...	...	8000	653
(4)	510	552	589	640	692	...	...	...	...	...	...	...	3000	692
(5)	...	...	...	...	...	...	...	...	...	...	...	...	....	...
(6)	515	585	...	...	...	...	...	...	...	...	...	...	700	600
(7)	360	429	460	519	564	610	...	...	...	...	...	...	4650	651
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	...
(9)	255	303	331	392	445	...	...	...	...	...	...	...	3900	496
(10)	110	144	168	223	306	...	...	...	...	...	...	...	3300	360
(11)	165	212	237	269	299	329	367	417	...	...	...	...	6600	472

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Continued*
(Butters 7 to 11)

	Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
							BUTTER 7							
(1)	8- 3-31	...	1.46058	38.30	224.12	4.19	.....	27.90	1.50	18.64	.62	....	250.36	5.35
(2)	10-12-31	93	1.46057	37.12	223.01	3.76	87.68	27.71	1.92	22.00	.54	9.96	251.08	....
(3)	12-21-31	91	1.45979	38.24	223.96	4.08	87.46	28.03	1.96	24.32	.48	8.56	250.50	5.02
(4)	3- 7-32	89	1.46061	39.26	223.86	3.49	86.30	28.34	1.18	24.32	.29	3.80	250.63	5.44
(5)	5- 9-32	89	1.46046	37.90	222.82	4.44	85.30	28.16	1.88	24.06	.51	4.92	251.82	5.00
(6)	7-18-32	...	1.46058	39.58	224.82	....	85.88	29.53	2.25	24.68	.50	....	249.58	....
(7)	9-26-32	85	1.46032	38.56	223.36	4.20	85.14	27.44	1.88	24.56	.51	5.19	251.20	4.64
(8)	12- 5-32	...	1.46049	39.11	223.94	3.64	86.59	27.72	2.32	24.36	.50	8.06	250.54	4.46
(9)	2-13-33	88	1.46042	40.66	223.22	4.10	.....	28.84	2.08	24.86	.48	8.54	251.35	4.55
(10)	4-24-33	86	1.46052	39.18	223.77	4.52	85.60	28.48	2.13	25.74	.52	6.48	250.74	4.61
(11)	7- 3-33	86	1.46071	39.88	223.89	4.40	87.37	28.50	2.22	25.82	.55	8.21	250.60	4.54
(12)	9-11-33	85.5	1.46056	39.50	225.00	4.23	85.58	29.07	2.47	26.74	.59	5.44	249.37	4.51
							BUTTER 8							
(1)	8- 3-31	...	1.46044	38.63	222.96	4.11	.....	27.58	1.54	22.40	.60	....	251.64	4.83
(2)	10-12-31	92	1.46056	37.45	223.54	4.02	86.52	27.81	1.74	22.41	.56	7.41	250.98	....
(3)	12-21-31	90	1.46052	37.90	222.63	4.01	88.04	27.84	1.96	24.02	.50	8.22	252.00	4.78
(4)	3- 7-32	88.5	1.46070	39.32	222.96	3.56	85.40	28.33	1.16	24.52	.30	3.98	251.63	4.78
(5)	5- 9-32	88	1.46052	38.38	222.74	4.46	85.93	28.17	1.91	23.66	.52	6.07	251.90	4.86
(6)	7-18-32	...	1.46060	39.72	225.14	5.02	86.42	29.41	2.30	24.50	.53	....	249.22	....
(7)	9-26-32	87	1.46062	38.68	223.26	4.20	85.50	27.82	1.90	23.88	.53	5.30	251.30	4.58
(8)	12- 5-32	...	1.46074	39.17	223.70	3.61	86.48	28.62	2.14	26.30	.51	8.69	250.82	4.38
(9)	2-13-33	88.5	1.46051	40.92	222.25	4.20	.....	28.49	2.06	25.08	.53	7.28	252.46	4.52
(10)	4-24-33	85.5	1.46065	39.88	223.90	4.50	86.46	28.56	2.07	25.69	.49	7.61	250.58	4.58
(11)	7- 3-33	85	1.46058	39.18	224.46	4.40	86.13	28.46	2.11	25.35	.55	5.52	249.97	4.52
(12)	9-11-33	85	1.46053	39.22	225.31	3.98	83.96	29.28	2.43	26.56	.63	5.26	249.02	4.51
							BUTTER 9							
(1)	8- 3-31	...	1.46020	38.28	223.34	4.38	.....	27.38	1.34	22.66	.53	....	251.22	5.07
(2)	10-12-31	91	1.46038	37.65	223.16	4.17	86.98	27.86	1.56	22.84	.55	9.59	251.40	....
(3)	12-21-31	90	1.46073	38.04	223.66	4.20	86.12	27.66	2.02	23.44	.49	9.08	250.84	4.75
(4)	3- 7-32	88.5	1.46065	39.30	223.44	3.55	85.86	28.06	1.25	24.42	.29	5.71	251.09	4.90
(5)	5- 9-32	88	1.46052	38.62	222.61	4.42	85.95	27.71	1.90	23.30	.53	5.55	252.05	4.83
(6)	7-18-32	...	1.46073	39.52	225.52	5.06	86.86	29.05	2.16	24.23	.51	....	248.78	....
(7)	9-26-32	87	1.46047	38.47	223.34	4.25	85.42	27.78	1.86	24.60	.53	4.85	251.22	4.60
(8)	12- 5-32	...	1.46068	38.88	222.98	3.68	87.06	28.43	2.04	25.75	.52	5.37	251.64	4.37
(9)	2-13-33	88.5	1.46039	41.09	221.93	4.36	....	28.88	1.98	25.29	.52	6.32	253.05	4.54
(10)	4-24-33	85	1.46051	38.72	223.55	4.56	86.66	28.68	2.07	25.78	.53	5.36	250.98	4.58
(11)	7- 3-33	84.5	1.46060	38.98	224.25	4.57	87.69	27.90	2.14	25.33	.56	8.27	250.20	4.54
(12)	9-11-33	85	1.46086	39.92	226.30	4.89	85.38	28.92	2.37	26.62	.68	5.15	247.93	4.56
							BUTTER 10							
(1)	8- 3-31	...	1.46056	39.08	225.22	3.54	86.45	27.66	1.66	20.97	.50	....	249.12	5.34
(2)	10-19-31	89	1.46058	38.13	224.45	3.82	87.12	27.82	1.88	21.50	.56	5.32	249.96	5.22
(3)	12-28-31	88	1.45881	38.05	222.75	3.64	85.76	28.42	2.05	23.02	.53	7.11	251.87	5.25
(4)	3- 7-32	89	1.46052	39.38	223.16	3.74	86.56	28.50	1.14	25.48	.29	3.22	251.40	5.33
(5)	5-16-32	88	1.46052	36.02	222.70	4.35	87.30	28.33	2.14	23.04	.54	6.22	251.94	5.31
(6)	7-25-32	88	1.46056	39.68	224.32	4.43	86.60	28.12	2.09	25.11	.55	....	250.16	4.64
(7)	10- 3-32	85.5	1.46070	38.66	223.36	4.28	87.46	28.76	2.19	25.60	.54	7.18	251.20	4.64
(8)	12-12-32	85	1.46048	39.74	221.36	3.50	87.03	28.30	1.95	25.35	.56	7.42	253.42	4.51
(9)	2-20-33	...	1.46048	40.42	222.86	4.61	87.04	28.22	2.09	25.78	.49	5.37	251.76	4.66
(10)	5- 1-33	84.5	1.46048	39.62	227.47	3.74	87.44	28.00	2.04	25.50	.55	....	246.66	4.86
(11)	7-10-33	84.5	1.46044	39.36	224.03	4.15	87.15	28.23	2.08	25.80	.54	7.86	250.46	4.63
(12)	9-18-33	...	1.46042	39.80	224.10	4.56	86.16	28.87	2.20	24.72	.57	6.15	250.38	4.56
							BUTTER 11							
(1)	8- 3-31	...	1.46056	38.80	225.27	3.54	86.24	27.18	1.46	21.33	.46	....	249.07	5.12
(2)	10-19-31	91	1.46050	38.46	224.08	3.84	88.61	27.43	1.91	20.79	.52	3.25	250.37	5.12
(3)	12-28-31	90	1.45952	37.57	223.07	3.68	86.10	27.86	2.06	23.56	.52	5.45	251.48	5.15
(4)	3- 7-32	90	1.46058	39.08	221.80	3.40	86.12	28.96	1.18	25.51	.28	4.97	252.35	5.27
(5)	5-16-32	89.5	1.46058	36.30	222.44	4.42	87.94	28.50	1.89	24.40	.52	5.47	252.24	5.23
(6)	7-25-32	89	1.46078	39.46	224.96	4.50	87.06	27.71	2.08	24.66	.51	....	249.41	4.82
(7)	10- 3-32	86.5	1.46071	39.12	223.26	4.34	86.78	28.74	2.04	25.42	.53	6.16	251.32	4.64
(8)	12-12-32	85.5	1.46070	39.06	222.28	3.74	87.44	28.38	1.86	25.58	.51	5.96	252.42	4.40
(9)	2-20-33	...	1.46056	39.60	222.29	4.62	86.32	28.64	1.98	25.46	.51	5.27	252.41	4.64
(10)	5- 1-33	84	1.46046	39.54	226.35	3.88	87.05	28.37	2.18	25.58	.60	....	247.88	4.76
(11)	7-10-33	84	1.46059	39.34	224.44	4.44	87.38	28.37	2.20	25.40	.54	7.83	250.00	4.56
(12)	9-18-33	...	1.46078	39.88	222.38	4.49	87.00	29.12	2.40	25.32	.56	4.94	252.30	4.49

TABLE 3B.—OXIDATION DATA—*Continued*
(Butters 7 to 11)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 7							
(1)	144	175	202	255	345	421	495	614	884	1066	...	...	9130	1117
(2)	446	476	504	538	569	623	685	720	791	879	1063	1184	12870	1556
(3)	376	413	445	501	560	617	679	755	870	957	1097	...	10560	1337
(4)	328	371	415	517	609	725	888	1152	1476	1937	...	...	9130	1992
(5)	240	282	326	406	474	556	652	839	1275	...	...	...	7810	1320
(6)	228	268	312	409	511	630	796	1011	1299	1607	2036	2263	11990	2791
(7)	97	199	239	305	358	421	483	547	667	773	875	1039	11990	1627
(8)	...	...	...	...	...	...	...	...	...	...	...	...	.....	....
(9)	301	354	404	527	620	782	996	1395	...	...	...	...	7040	1559
(10)	329	358	445	742	872	1024	1247	1532	1862	2155	...	...	9680	2358
(11)	280	320	356	424	494	565	637	705	784	...	...	...	8690	1048
(12)	128	165	190	249	296	350	417	584	848	1430	2228	...	10450	2723
							BUTTER 8							
(1)	...	...	...	...	...	...	...	...	...	...	...	...	....	...
(2)	505	532	562	614	665	718	780	833	913	992	1097	...	10780	1362
(3)	245	294	331	377	429	501	610	710	784	867	961	1287	12540	1960
(4)	164	199	236	321	382	449	552	676	904	...	...	...	8030	1077
(5)	219	278	316	418	525	654	906	...	...	...	...	...	6380	1376
(6)	266	310	342	392	437	498	561	689	834	1031	1365	1680	12980	2659
(7)	200	234	267	325	378	506	728	977	1328	1812	2833	...	9900	2833
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(9)	196	269	313	394	481	593	776	...	...	...	...	...	8580	2391
(10)	317	420	478	531	638	761	1130	...	...	...	...	...	8140	2812
(11)	425	554	587	637	698	757	814	906	990	1096	1186	...	10340	1374
(12)	143	232	250	357	530	652	952	1258	...	...	...	...	7040	1339
							BUTTER 9							
(1)	106	...	...	216	290	325	431	532	664	...	...	...	8250	711
(2)	507	537	576	635	690	741	804	877	955	1046	1249	...	10450	1563
(3)	267	303	329	385	433	481	524	571	615	694	753	830	15180	1401
(4)	268	320	362	445	514	597	688	...	...	...	...	...	7480	1411
(5)	293	342	378	452	541	643	753	1030	1885	...	...	...	8250	2546
(6)	365	...	...	...	570	...	...	...	...	...	...	...	9790	1280
(7)	303	361	392	454	506	573	628	701	793	1198	1497	...	10230	1621
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(9)	317	363	403	521	680	892	1171	1643	...	...	...	...	8580	2693
(10)	483	503	534	628	695	795	903	1021	1163	1416	...	...	9020	1455
(11)	380	416	453	509	576	641	720	807	888	1008	...	...	9570	1146
(12)	122	140	168	222	386	496	899	1390	...	...	...	...	9350	2591
							BUTTER 10							
(1)	206	254	286	350	400	454	512	569	641	737	942	1033	14190	1448
(2)	344	365	386	445	502	556	606	664	725	787	859	1010	12320	1305
(3)	381	422	468	568	624	701	755	838	956	1074	1177	1353	17050	2974
(4)	228	286	321	388	451	527	602	691	817	...	...	...	8470	1028
(5)	496	544	580	655	753	849	1065	1607	...	...	...	...	6600	1607
(6)	347	397	438	522	608	702	809	940	1133	1341	1616	1883	13750	2740
(7)	330	384	433	596	895	1312	...	...	...	...	...	...	4620	1378
(8)	338	...	...	...	...	...	...	...	...	1195	...	...	9240	2422
(9)	410	452	489	559	628	732	838	945	1129	...	...	...	8580	1492
(10)	843	1156	1189	1264	1368	1487	1588	...	...	...	...	2569	11330	2592
(11)	322	345	371	420	470	526	587	653	742	842	1229	...	10230	1428
(12)	167	188	229	316	454	556	913	...	...	...	...	...	9350	4150
							BUTTER 11							
(1)	631	701	740	794	915	1001	...	...	...	...	...	...	5390	1387
(2)	259	288	317	373	414	454	497	549	620	690	758	852	13200	1391
(3)	208	248	265	346	396	450	520	585	651	731	790	868	15180	1729
(4)	188	231	268	339	399	466	542	626	723	931	...	...	9130	1152
(5)	319	372	417	756	990	1080	1195	1661	2294	2803	3263	3761	11110	3810
(6)	338	364	390	450	502	573	651	...	...	...	...	...	6270	747
(7)	286	344	405	532	666	813	1002	1245	...	...	...	...	7370	1536
(8)	293	345	365	...	...	...	...	...	...	...	...	1379	11220	1460
(9)	221	255	279	351	413	475	550	631	720	819	982	...	10890	1266
(10)	400	462	530	729	1058	...	...	...	...	...	...	...	4620	2694
(11)	283	339	387	556	716	833	1031	1253	1412	1718	2354	...	10340	2580
(12)	272	289	309	367	448	955	1205	...	...	...	...	...	5830	1287

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Continued*
(Butters 12 to 16)

	Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
						BUTTER 12								
(1)	8- 3-31	...	1.46051	38.24	224.87	3.93	.....	28.85	1.80	21.16	.46	....	249.52	4.81
(2)	10-19-31	90	1.46061	37.82	224.74	3.62	88.36	27.81	1.58	21.55	.52	3.36	249.64	4.95
(3)	12-28-31	89	1.46087	37.95	222.52	3.96	86.55	27.51	1.92	22.86	.54	5.77	252.14	4.95
(4)	3- 7-32	89.5	1.46046	39.25	222.54	3.88	86.55	28.60	1.14	25.06	.29	3.40	252.10	5.10
(5)	5-16-32	89	1.46015	36.15	222.44	4.61	87.86	28.10	1.97	24.34	.52	5.12	252.24	6.00
(6)	7-25-32	89	1.46067	39.04	223.82	4.42	88.02	27.97	2.08	25.44	.55	....	250.68	4.81
(7)	10- 3-32	87	1.46069	38.23	223.06	4.54	86.58	28.84	2.06	25.55	.54	6.25	251.53	4.52
(8)	12-12-32	85.5	1.46070	39.06	222.28	3.74	87.44	28.38	1.86	25.58	.51	5.96	252.42	4.40
(9)	2-20-33	...	1.46056	39.60	222.29	4.62	86.32	28.64	1.98	25.46	.51	5.27	252.41	4.64
(10)	5- 1-33	84	1.46046	36.85	225.77	3.92	87.76	28.98	1.97	26.05	.58	4.04	248.52	4.68
(11)	7-10-33	84	1.46064	39.44	224.11	4.58	86.94	28.24	2.16	25.48	.56	6.06	250.36	4.44
(12)	9-18-33	...	1.46079	39.61	224.54	4.57	87.64	29.08	2.24	25.64	.55	5.56	249.88	4.43
						BUTTER 13								
(1)	8-17-31	...	1.46032	37.32	223.78	3.90	85.44	28.80	2.44	23.30	.38	....	250.74	6.84
(2)	10-26-31	...	1.46051	37.27	223.93	3.38	87.37	27.72	1.85	19.56	.50	7.34	250.48	5.77
(3)	1- 4-32	...	1.46031	37.88	223.43	3.99	86.87	28.45	1.87	23.42	.49	3.56	251.10	5.70
(4)	3-14-32	90	1.46038	38.03	223.88	3.91	87.57	28.14	1.70	25.06	.34	4.26	250.60	6.35
(5)	5-23-32	88	1.46014	37.72	224.22	4.38	86.98	28.74	2.05	24.00	.53	7.87	250.23	5.86
(6)	8- 1-32	90	1.46071	38.66	223.88	4.26	85.12	29.58	2.24	26.04	.59	....	250.62	5.00
(7)	10-10-32	91	1.46009	38.27	223.92	4.44	86.81	27.89	2.34	25.05	.57	6.48	250.58	4.95
(8)	12-19-32	90	1.46057	38.46	222.68	4.22	86.78	28.88	2.26	26.50	.58	5.55	251.96	4.86
(9)	2-27-33	90	1.46052	38.86	224.90	4.36	87.28	28.47	2.30	24.78	.60	7.30	249.51	5.03
(10)	5- 8-33	87	1.46053	38.04	224.50	4.52	87.08	28.62	2.24	25.48	.61	5.92	249.93	4.97
(11)	7-17-33	...	1.46055	38.00	224.78	4.18	86.21	28.78	2.18	24.34	.63	9.01	249.62	....
(12)	9-25-33	...	1.46060	38.76	224.52	4.86	88.11	28.16	2.28	25.84	.68	5.07	249.91	4.80
						BUTTER 14								
(1)	8-17-31	...	1.46050	37.28	223.97	4.20	86.06	29.45	1.98	23.13	.44	9.97	250.52	4.80
(2)	10-26-31	...	1.46038	37.14	224.07	4.00	86.04	27.96	2.06	20.95	.44	3.43	250.39	5.64
(3)	1- 4-32	...	1.46037	37.74	223.24	4.15	86.37	28.22	1.88	23.36	.45	4.74	251.32	5.27
(4)	3-14-32	...	1.46050	37.84	223.30	4.11	87.26	27.87	2.07	25.58	.28	5.28	251.24	5.08
(5)	5-23-32	80	1.46002	36.92	224.08	4.46	85.84	28.07	2.80	23.48	.39	8.62	250.40	5.29
(6)	8- 1-32	...	1.46076	37.14	222.96	4.40	84.43	29.48	2.42	26.37	.59	....	251.66	4.88
(7)	10-10-32	...	1.46054	37.71	223.04	4.71	86.06	28.16	2.38	25.34	.59	5.72	251.56	4.50
(8)	12-19-32	...	1.46066	38.08	223.16	4.30	85.94	29.11	2.33	26.46	.57	7.73	251.42	4.49
(9)	2-27-33	...	1.46054	38.14	225.08	5.03	87.46	28.88	2.26	25.26	.68	7.30	249.28	4.49
(10)	5- 8-33	...	1.46070	37.76	224.32	4.78	87.10	28.26	2.36	25.56	.68	5.70	250.14	4.42
(11)	7-17-33	...	1.46019	37.71	225.33	4.66	86.52	28.44	2.24	24.72	.73	6.30	249.01	....
(12)	9-25-33	...	1.46074	37.73	225.22	4.88	87.50	28.48	2.64	25.88	.70	5.55	249.12	4.39
						BUTTER 15								
(1)	8-17-31	...	1.46059	37.58	224.72	4.25	85.36	28.76	2.30	22.49	.39	3.92	249.68	7.94
(2)	10-26-31	...	1.46032	37.38	224.50	4.16	85.18	27.72	1.93	20.04	.47	3.57	249.91	6.79
(3)	1- 4-32	...	1.46068	37.82	224.03	4.32	87.40	27.90	1.90	23.11	.49	7.57	250.43	6.91
(4)	3-14-32	...	1.46056	38.18	224.32	4.28	87.60	27.60	1.72	25.08	.32	5.45	250.10	6.43
(5)	5-23-32	...	1.46012	37.92	224.04	4.20	86.58	28.36	1.94	23.56	.47	7.03	250.44	7.03
(6)	8- 1-32	...	1.46069	38.20	222.69	4.62	87.36	31.37	2.30	26.36	.59	....	251.96	5.70
(7)	10-10-32	...	1.46058	38.40	224.46	4.70	86.42	28.56	2.14	25.26	.53	4.27	249.96	5.84
(8)	12-19-32	...	1.46056	38.76	224.06	4.36	86.62	28.84	2.28	26.20	.51	7.70	250.41	5.69
(9)	2-27-33	...	1.46048	38.69	224.46	4.83	87.27	28.58	2.54	25.14	.52	5.87	249.97	5.36
(10)	5- 8-33	...	1.46056	38.06	224.19	4.76	87.02	28.50	2.10	25.38	.53	5.85	250.26	5.33
(11)	7-17-33	...	1.46052	35.88	225.88	4.42	87.18	28.42	2.36	24.88	.62	7.68	248.40	....
(12)	9-25-33	...	1.46068	38.40	224.90	4.82	87.72	28.46	2.11	26.61	.59	4.82	249.49	5.29
						BUTTER 16								
(1)	8-17-31	...	1.46023	37.02	225.61	3.90	86.02	27.78	1.94	23.91	.51	2.40	248.70	6.83
(2)	11- 2-31	87	1.46034	37.24	226.12	4.04	88.22	27.68	1.53	22.90	.48	5.85	248.12	6.37
(3)	1-11-32	...	1.46052	37.99	223.10	....	87.06	29.01	2.02	22.17	.46	7.10	251.47	7.15
(4)	3-21-32	...	1.46056	38.59	224.70	4.00	87.68	28.80	1.56	25.80	.47	2.75	249.68	6.84
(5)	5-31-32	...	1.46035	37.96	225.26	4.27	86.35	30.44	2.39	24.35	.50	5.43	249.08	6.77
(6)	8- 8-32	...	1.46059	38.50	225.60	4.42	86.24	29.04	2.29	25.62	.50	5.15	248.73	....
(7)	10-17-32	...	1.46054	38.25	224.60	4.49	86.66	28.35	2.28	25.40	.51	4.91	249.82	5.43
(8)	12-26-32	...	1.46059	38.78	223.64	4.74	87.06	28.15	2.06	26.14	.49	8.00	250.88	5.42
(9)	3- 6-33	...	1.46048	38.18	225.11	4.71	86.79	28.80	2.26	25.56	.50	7.46	249.25	5.50
(10)	5-15-33	...	1.46056	38.00	225.07	4.61	87.08	28.42	2.08	25.18	.51	5.87	249.29	5.50
(11)	7-24-33	...	1.46070	38.12	224.92	3.86	87.66	28.13	2.26	25.34	.60	8.50	249.46	5.59

TABLE 3B.—OXIDATION DATA—*Continued*
(Butters 12 to 16)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 12							
(1)	301	316	349	414	457	506	559	602	667	765	873	971	13530	1461
(2)	257	283	314	386	425	464	525	571	628	677	738	805	14080	1308
(3)	322	362	410	505	588	672	766	877	981	1264	...	...	9350	1470
(4)	287	339	384	463	541	629	728	860	1035	1410	1963	2585	11220	2814
(5)	271	358	446	541	639	773	954	1144	...	...	...	...	7260	1455
(6)	337	391	451	577	712	860	1004	1223	1514	1819	2106	...	9900	2106
(7)	169	191	222	262	306	361	408	461	515	573	649	721	14300	1622
(8)	293	345	...	...	...	...	...	...	...	...	...	1379	11220	1460
(9)	221	255	279	351	413	475	550	631	720	819	982	...	10890	1266
(10)	164	263	403	549	632	724	831	933	1020	1188	1424	1731	11990	2443
(11)	370	428	514	648	825	953	1039	1174	1354	1572	...	...	12870	2478
(12)	334	352	375	...	...	...	...	...	...	...	...	...	....	....
							BUTTER 13							
(1)	264	294	324	378	429	473	529	595	660	733	875	979	18260	1884
(2)	363	430	508	663	928	1106	1229	1336	1458	1531	1605	1692	15730	2644
(3)	771	811	828	940	991	1047	1123	1207	1293	1330	1399	1500	14520	2139
(4)	438	681	942	1052	1110	1192	1263	1354	1472	1597	1762	2127	13200	3102
(5)	619	1096	1162	1300	1422	1737	...	...	...	...	...	...	5060	1882
(6)	487	528	566	636	702	766	857	947	1048	1145	1300	...	10120	1331
(7)	405	629	703	800	910	1021	1155	1289	1496	2027	...	...	9570	2668
(8)	768	812	843	934	1006	1079	...	...	1329	1455	...	2440	11000	2440
(9)	725	765	807	883	970	1223	1364	1520	...	...	...	...	7920	2420
(10)	736	785	856	1031	1165	1285	...	...	...	...	...	...	5720	2420
(11)	511	...	...	...	...	...	...	...	...	...	...	...	5280	2400
(12)	283	390	443	547	658	768	859	970	1049	1128	1232	1347	11110	1397
							BUTTER 14							
(1)	112	185	221	...	...	...	...	...	...	...	...	821	11990	1071
(2)	110	154	185	240	305	376	451	523	600	704	909	1143	11660	1370
(3)	146	193	237	349	441	598	949	...	1353	1609	...	...	13200	3091
(4)	125	196	260	402	564	726	928	1289	...	...	...	...	6710	1303
(5)	...	212	249	334	402	456	510	566	628	702	786	867	15950	1355
(6)	128	153	183	238	323	399	461	574	888	...	...	...	8140	1292
(7)	100	192	253	368	486	631	796	1113	1614	2442	3074	3397	12540	4147
(8)	199	256	324	...	...	...	...	...	...	...	...	...	4840	2769
(9)	424	...	...	1400	1896	2460	2750	2991	...	...	...	...	6710	3048
(10)	143	175	207	284	347	451	634	838	1122	1673	2369	...	10560	2736
(11)	141	173	226	451	738	982	...	...	...	...	...	...	9240	3798
(12)	272	323	410	607	983	...	...	...	...	...	...	...	4180	1275
							BUTTER 15							
(1)	455	1124	1869	3463	...	...	...	...	...	...	...	...	2640	4096
(2)	143	320	418	707	1187	...	...	...	...	...	...	...	3850	1712
(3)	382	604	1473	1768	2599	2938	3307	...	...	...	...	...	8580	4310
(4)	451	908	1747	2222	...	...	...	...	...	...	...	...	2310	2520
(5)	238	390	492	718	946	1215	1549	1884	2199	2494	...	...	9350	2716
(6)	548	944	1308	1994	2570	3135	3582	...	...	...	...	...	6050	4096
(7)	824	...	...	...	...	...	...	...	...	...	...	...	2970	2737
(8)	980	1436	1670	...	...	...	...	...	...	...	...	...	2860	2891
(9)	374	745	1005	2132	...	...	...	...	...	...	...	...	2310	2477
(10)	403	1337	1411	1652	1760	2036	2232	2465	2656	...	...	...	7920	2748
(11)	...	...	...	...	...	...	...	...	...	...	...	...	1650	1191
(12)	265	422	734	...	...	...	...	...	...	...	...	...	....	....
							BUTTER 16							
(1)	...	977	1615	...	...	...	...	...	...	...	...	...	1540	2418
(2)	78	166	344	799	1221	...	...	...	...	...	...	...	3740	1495
(3)	...	1575	1639	1837	No further absorption altho run was continued 500 min. beyond 2988								3190	2988
(4)	331	702	1034	1960	...	...	...	...	...	...	...	...	3190	2825
(5)	120	189	273	471	808	1092	1394	1814	...	...	...	...	7040	1959
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	692	917	1067	1236	...	...	...	...	...	...	...	...	2200	1236
(8)	635	1097	...	...	...	...	...	...	...	...	...	...	3190	4185
(9)	1022	2191	...	...	...	...	...	...	...	...	...	...	770	2663
(10)	...	...	...	...	...	...	...	...	...	...	...	...	....	...
(11)	302	445	563	928	1174	1482	...	...	...	...	...	...	4400	1482

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Continued*
(Butters 17 to 21)

	Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
							BUTTER 17							
(1)	8–17–31	...	1.46048	37.00	225.74	4.10	85.01	27.46	1.79	23.72	.48	3.42	248.56	7.01
(2)	11– 2–31	90	1.46016	37.05	225.12	3.99	87.64	27.98	1.92	22.84	.47	4.10	249.22	7.30
(3)	1–11–32	...	1.46052	38.36	223.66	3.14	87.44	29.00	1.95	22.35	.47	8.04	250.84	7.32
(4)	3–21–32	90	1.46050	38.26	223.70	4.06	87.98	29.70	1.61	24.51	.52	4.75	250.80	7.17
(5)	5–31–32	...	1.46047	37.39	224.43	4.27	87.21	29.28	2.60	24.24	.49	3.43	250.00	7.10
(6)	8– 8–32	...	1.46050	38.04	223.82	4.31	85.31	29.06	2.30	25.34	.49	6.19	250.68	....
(7)	10–17–32	...	1.46046	38.18	223.95	4.11	86.70	28.50	1.98	25.40	.54	5.55	250.54	5.57
(8)	12–26–32	...	1.46056	38.80	223.10	4.48	87.16	28.42	2.03	25.78	.48	7.56	251.49	5.55
(9)	3– 6–33	...	1.46048	38.28	225.60	4.50	86.15	28.76	2.02	25.37	.49	7.27	248.70	5.55
(10)	5–15–33	...	1.46054	38.21	226.18	4.66	87.23	28.62	2.12	25.27	.53	6.91	248.06	5.53
(11)	7–24–33	...	1.46019	38.18	225.74	4.10	87.93	28.36	2.40	25.30	.57	7.73	248.55	5.57
							BUTTER 18							
(1)	8–17–31	...	1.46035	37.28	224.90	4.08	85.76	27.16	1.71	24.28	.53	3.00	249.48	6.15
(2)	11– 2–31	89.5	1.46051	37.22	225.14	3.90	87.83	28.08	1.81	20.39	.56	4.78	249.20	6.49
(3)	1–11–32	...	1.46015	38.26	222.98	3.02	86.40	28.38	1.91	21.71	.58	7.41	251.62	6.81
(4)	3–21–32	88	1.46073	38.27	223.81	3.92	87.94	29.10	1.60	24.43	.59	4.88	250.67	6.71
(5)	5–31–32	...	1.46036	38.14	224.58	4.25	87.38	28.42	1.94	24.48	.60	4.67	249.84	6.52
(6)	8– 8–32	...	1.46035	37.82	222.66	4.35	85.90	29.12	2.24	24.82	.63	6.03	252.00	....
(7)	10–17–32	...	1.46059	38.32	224.08	4.20	85.27	28.64	2.08	25.30	.60	4.82	250.40	5.38
(8)	12–26–32	...	1.46039	38.96	223.56	4.51	87.27	28.50	2.06	26.05	.53	5.24	250.98	5.42
(9)	3– 6–33	...	1.46048	38.18	225.50	4.55	85.95	28.67	2.10	26.10	.60	8.39	248.82	5.38
(10)	5–15–33	...	1.46055	38.14	225.68	4.64	86.69	28.46	2.16	24.89	.61	5.28	248.62	5.29
(11)	7–24–33	...	1.46068	37.77	225.42	4.06	87.68	28.60	2.31	25.50	.69	6.72	248.89	5.22
(12)	10– 2–33	...	1.46055	38.12	224.90	4.84	87.14	28.86	2.22	26.16	.68	5.46	249.48	5.26
							BUTTER 19							
(1)	8–27–31	...	1.46014	36.86	226.32	3.60	87.56	28.14	2.22	24.94	.39	3.65	247.92	6.80
(2)	11– 9–31	92.5	1.46072	36.72	226.60	3.27	86.80	29.20	1.98	23.38	.44	6.34	247.60	6.89
(3)	1–18–32	90	1.46036	38.00	224.32	4.41	86.75	29.02	1.70	24.90	.40	6.15	250.11	6.55
(4)	3–28–32	90.5	1.46018	36.95	224.50	3.18	87.38	30.24	1.87	25.88	.38	4.49	249.92	6.37
(5)	6– 6–32	89.5	1.46034	36.87	224.00	4.47	86.12	28.44	2.14	23.40	.50	4.52	250.48	6.95
(6)	8–15–32	90	1.46025	38.78	225.86	4.44	85.60	29.67	2.39	25.81	.46	5.27	248.42	5.37
(7)	10–24–32	...	1.46018	37.85	224.42	4.96	86.98	29.30	2.06	24.93	.53	7.66	250.00	5.24
(8)	1– 2–33	89.5	1.46061	38.01	223.34	4.92	86.31	29.72	2.34	26.55	.50	5.60	251.22	....
(9)	3–13–33	87.5	1.46026	37.18	224.88	4.40	86.58	29.18	2.32	25.46	.48	6.69	249.50	5.36
(10)	5–22–33	88	1.46021	37.65	225.99	4.70	87.07	29.42	2.32	24.95	.55	5.96	248.28	5.18
(11)	7–31–33	...	1.46056	37.38	226.58	4.32	.....	29.15	2.56	24.99	.51	5.13	247.63	5.17
(12)	10– 9–33	87.5	1.46031	38.90	226.32	4.78	87.60	29.38	2.30	26.82	.59	6.44	247.92	5.14
							BUTTER 20							
(1)	8–27–31	...	1.46021	36.87	226.28	3.86	86.60	27.78	1.83	25.07	.35	5.39	247.78	7.23
(2)	11– 9–31	90	1.46020	36.71	226.04	3.52	86.71	28.00	1.76	22.26	.46	7.49	248.20	7.17
(3)	1–18–32	89	1.46037	37.82	224.28	4.64	86.27	29.08	1.67	25.54	.32	8.78	250.16	7.00
(4)	3–28–32	88.5	1.46012	37.24	224.52	3.33	87.93	29.90	1.64	25.56	.28	5.12	249.88	6.72
(5)	6– 6–32	88	1.46018	37.22	224.14	4.60	86.50	28.36	1.85	23.66	.36	4.33	250.33	7.29
(6)	8–15–32	89	1.46051	38.18	225.51	4.71	85.55	29.46	2.41	25.68	.31	3.42	248.80	5.70
(7)	10–24–32	...	1.46038	37.71	224.44	4.76	87.72	29.23	2.10	25.28	.45	6.67	249.98	5.36
(8)	1– 2–33	86	1.46062	38.30	223.70	4.88	86.92	29.63	2.30	26.74	.35	7.16	250.82	....
(9)	3–13–33	85.5	1.46044	37.64	225.36	4.41	85.97	29.36	2.34	24.98	.40	7.22	248.97	5.55
(10)	5–22–33	85	1.46030	37.75	226.74	4.69	87.42	29.25	2.39	25.76	.37	5.40	247.46	5.57
(11)	7–31–33	...	1.46056	37.16	226.44	4.52	.....	29.37	2.71	23.36	.52	6.40	247.78	5.47
(12)	10– 9–33	84	1.46033	38.22	225.96	5.00	87.84	29.52	2.38	27.07	.43	8.09	248.32	5.33
							BUTTER 21							
(1)	8–27–31	...	1.46011	36.62	226.48	3.84	87.33	28.25	1.78	24.71	.37	3.02	247.74	5.50
(2)	11– 9–31	91	1.46020	36.18	226.22	....	87.43	28.42	1.95	21.60	.46	5.76	248.02	5.72
(3)	1–18–32	88.5	1.46021	37.58	224.16	4.49	85.70	29.03	1.72	25.10	.40	6.65	250.28	5.79
(4)	3–28–32	91	1.46048	36.83	224.41	....	87.72	29.76	1.65	25.50	.35	5.10	250.01	6.52
(5)	6– 6–32	90	1.46009	36.95	224.50	4.53	86.27	29.33	1.94	23.52	.46	3.72	249.92	7.51
(6)	8–15–32	89.5	1.46028	38.26	224.92	4.70	84.94	29.86	2.50	26.92	.45	6.43	249.46	5.58
(7)	10–24–32	...	1.46027	37.74	224.68	4.76	87.46	29.18	2.18	25.60	.51	5.60	249.73	5.36
(8)	1– 2–33	89	1.46051	37.78	223.99	4.86	86.68	29.66	2.18	26.94	.47	8.17	250.50	....
(9)	3–13–33	89	1.46032	37.40	224.86	4.36	86.41	29.14	1.91	25.76	.48	8.12	249.52	5.12
(10)	5–22–33	89	1.46017	37.62	226.50	4.87	87.42	29.64	2.39	26.10	.53	7.50	247.72	5.43
(11)	7–31–33	...	1.46045	37.48	226.94	4.60	.....	28.62	2.48	25.74	.49	4.88	247.24	5.33
(12)	10– 9–33	88.5	1.46034	38.89	226.02	5.10	87.65	29.36	2.42	26.62	.56	7.26	248.24	5.27

TABLE 3B.—OXIDATION DATA—*Continued*
(Butters 17 to 21)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 17							
(1)	64	83	829	...	...	...	...	...	...	...	...	...	1320	2239
(2)	...	...	...	1042	...	...	...	...	...	...	...	...	2640	1183
(3)	347	619	885	1669	...	...	...	...	...	...	...	...	3080	2410
(4)	415	625	905	1411	...	...	...	...	...	...	...	...	2200	1411
(5)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(6)	616	798	1870	2543	...	...	...	...	...	...	...	...	2200	2543
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	296	505	1051	...	...	...	...	...	...	...	...	...	2750	4117
(9)	465	625	1033	1964	...	...	...	...	...	...	...	...	3080	2710
(10)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(11)	217	304	384	514	784	...	...	...	...	...	...	...	3850	881
							BUTTER 18							
(1)	2022	4215	...	...	...	...	...	...	...	...	...	...	550	4215
(2)	794	...	1300	...	...	...	...	...	...	...	...	...	1210	1418
(3)	810	961	...	...	...	...	...	...	...	...	...	...	770	1032
(4)	338	420	593	1218	1621	2182	...	...	...	...	...	...	5060	2538
(5)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	286	1100	1298	2765	...	...	...	...	...	...	...	...	2200	2765
(9)	410	631	994	1787	...	...	...	...	...	...	...	...	2970	2295
(10)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(12)	287	...	...	...	...	...	...	...	...	...	...	...	770	1406
							BUTTER 19							
(1)	493	585	739	816	865	919	976	1022	1095	1167	1260	1377	12210	1510
(2)	413	490	642	705	744	781	816	851	889	930	986	1040	16940	2332
(3)	812	866	909	972	1024	1091	1171	1234	1313	1406	1516	1636	16390	2677
(4)	267	582	652	743	813	879	937	1029	1142	1244	1320	2440	11110	2595
(5)	138	154	186	226	272	311	364	410	469	554	659	811	13420	1368
(6)	318	509	635	783	911	...	...	...	...	...	...	...	4290	1167
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(9)	481	526	566	651	727	827	914	1066	1499	...	...	...	7700	1499
(10)	1046	1221	1397	...	...	...	...	...	...	...	...	...	1100	1397
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(12)	603	622	658	715	768	837	931	1021	1241	1709	...	...	8910	1719
							BUTTER 20							
(1)	518	540	574	616	666	718	770	830	912	1012	1189	1377	11110	1384
(2)	...	...	339	400	455	525	597	667	747	828	913	1024	13420	1434
(3)	812	866	909	972	1024	1091	1171	1234	1313	1406	1516	1636	16390	2977
(4)	426	474	512	586	656	737	836	972	1316	...	...	...	8250	1559
(5)	225	253	279	321	...	...	...	...	...	...	...	...	12540	1636
(6)	332	511	566	641	699	769	832	879	958	1054	1178	...	10560	1335
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(9)	695	774	841	931	1018	1103	1201	1310	1714	2094	...	...	9570	2479
(10)	1541	1636	1710	1881	2033	2179	...	...	...	...	...	...	5060	2257
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(12)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
							BUTTER 21							
(1)	321	559	644	718	767	821	870	932	1005	1086	1190	1321	12980	1673
(2)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(3)	677	727	778	869	969	1079	1298	1551	1818	...	...	...	7700	1818
(4)	565	644	692	781	868	975	1108	1306	2363	...	...	...	8580	2899
(5)	448	475	518	578	640	704	799	882	1042	1165	1426	...	10010	1434
(6)	357	658	776	887	969	1079	1220	1416	1713	2060	2498	3103	13200	4009
(7)	237	386	547	704	762	818	876	934	1016	1063	1132	1218	11660	1258
(8)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(9)	644	715	771	856	927	1000	1066	1152	1222	...	...	...	11220	2611
(10)	1311	1981	2057	2213	2355	2499	2703	3065	3551	...	...	...	8140	3793
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(12)	559	594	626	686	758	833	922	1082	...	...	...	...	7040	1243

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Continued*
(Butters 22 to 27)

	Date	Score	Index of refraction	Iodin No.	Sapon No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
						BUTTER 22								
(1)	8-27-31	...	1.46019	37.07	226.42	3.51	87.54	29.64	2.36	21.91	.40	2.69	247.80	....
(2)	11-16-31	...	1.46032	36.06	227.20	3.50	86.45	28.64	1.91	21.82	.44	4.92	246.94	....
(3)	2- 1-32	...	1.46030	37.28	227.18	4.47	87.50	28.54	2.48	24.64	.41	7.43	246.99	....
(4)	4- 4-32	...	1.46043	37.41	224.62	3.30	86.60	31.20	1.70	26.36	.40	3.46	249.78	....
(5)	6-13-32	...	1.46030	37.00	223.59	4.28	85.68	30.31	2.16	21.86	.43	4.02	250.94	....
(6)	8-22-32	...	1.46055	36.54	224.38	3.86	87.44	29.22	2.36	24.99	.42	5.54	250.05	....
(7)	10-31-32	...	1.46019	36.89	223.86	4.46	87.39	28.92	2.20	25.49	.41	4.39	250.64	....
(8)	1- 9-33	...	1.46050	37.41	225.04	4.36	86.92	29.46	2.36	25.14	.42	4.29	249.36	....
(9)	3-20-33	...	1.46034	38.52	226.09	4.46	85.88	29.12	2.31	26.14	.41	6.79	248.18	....
(10)	5-29-33	...	1.46022	38.82	224.77	4.59	87.33	28.99	2.48	25.79	.47	3.79	249.62	....
(11)	8- 7-33	...	1.46038	37.26	224.44	4.26	86.98	29.24	2.62	24.92	.51	5.25	249.98	....
						BUTTER 23								
(1)	8-27-31	...	1.46019	37.30	226.74	3.46	86.91	28.72	2.04	21.84	.45	4.16	247.43	....
(2)	11-16-31	...	1.46040	36.07	226.13	3.96	86.13	28.32	1.86	21.04	.49	8.26	248.10	....
(3)	2- 1-32	...	1.46034	37.28	227.70	4.74	87.74	28.36	2.48	25.22	.46	6.98	246.39	....
(4)	4- 4-32	...	1.46038	37.14	224.25	3.33	87.26	30.38	1.62	25.88	.48	6.02	250.18	....
(5)	6-13-32	...	1.46018	37.16	224.02	4.52	87.22	28.02	2.08	22.95	.46	5.04	250.46	....
(6)	8-22-32	...	1.46038	36.84	225.06	4.02	87.94	29.52	2.32	25.88	.46	4.88	249.37	....
(7)	10-31-32	...	1.46006	37.78	224.22	4.24	87.36	28.52	2.12	25.28	.45	4.05	250.24	....
(8)	1- 9-33	...	1.46048	37.69	224.62	4.46	87.14	29.34	2.28	25.18	.48	7.37	249.79	....
(9)	3-20-33	...	1.46034	38.60	225.54	4.38	86.09	29.10	2.52	26.06	.46	6.90	248.78	....
(10)	5-29-33	...	1.46035	38.08	224.76	4.26	87.52	28.63	2.46	25.50	.48	5.02	249.64	....
(11)	8- 7-33	...	1.46022	37.48	224.39	4.26	87.10	29.16	2.44	25.96	.52	6.29	250.05	....
(12)	10-16-33	...	1.46022	38.40	226.34	3.86	87.02	29.74	2.46	26.15	.59	6.54	247.91	....
						BUTTER 24								
(1)	8-27-31	...	1.46038	37.24	225.62	3.39	87.65	28.80	2.02	21.02	.36	3.62	248.66	....
(2)	11-16-31	...	1.46018	36.13	224.66	4.12	86.46	28.09	1.90	22.74	.38	6.78	249.72	....
(3)	2- 1-32	...	1.46020	37.46	226.72	4.48	87.82	28.04	2.46	25.16	.37	3.99	247.46	....
(4)	4- 4-32	...	1.46035	37.24	224.24	3.40	87.02	30.52	1.64	26.02	.37	5.72	250.19	....
(5)	6-13-32	...	1.46046	37.43	224.32	4.22	86.91	28.56	2.06	23.46	.36	5.82	250.12	....
(6)	8-22-32	...	1.46016	36.93	224.98	3.98	87.80	29.20	2.34	25.99	.38	5.59	249.40	....
(7)	10-31-32	...	1.46034	37.30	223.56	4.37	87.44	28.75	1.99	25.48	.38	4.67	250.98	....
(8)	1- 9-33	...	1.46053	37.94	224.36	4.40	87.04	29.38	2.31	25.60	.41	6.49	250.08	....
(9)	3-20-33	...	1.46039	38.45	225.00	4.42	87.09	28.91	2.32	26.14	.39	6.54	249.38	....
(10)	5-29-33	...	1.46024	38.22	224.82	4.30	87.36	28.72	2.38	26.30	.42	3.85	249.58	....
(11)	8- 7-33	...	1.46018	37.71	224.20	4.08	87.40	29.00	2.42	25.66	.41	6.37	250.26	....
						BUTTER 25								
(1)	9-14-31	...	1.46024	36.62	224.50	3.79	87.34	27.92	2.24	22.98	.42	6.92	249.92	....
(2)	11-23-31	92	1.46035	36.28	225.18	4.62	85.19	28.16	1.98	20.48	.37	7.77	249.16	8.21
(3)	2- 1-32	91.5	1.46016	37.70	225.87	4.30	85.92	28.94	2.52	25.34	.47	4.73	248.40	....
(4)	4-11-32	90	1.46050	37.60	223.79	4.64	85.64	28.38	1.73	22.47	.50	3.32	250.72	5.84
(5)	6-20-32	90	1.46034	36.76	224.44	4.20	86.24	28.58	1.88	24.85	.54	4.69	249.98	7.03
(6)	8-29-32	89.5	1.46038	37.10	223.80	4.26	84.46	28.24	2.56	24.62	.53	6.71	250.70	4.66
(7)	11- 7-32	90	1.46011	39.80	223.08	4.66	87.64	28.36	2.22	25.94	.58	6.68	251.52	4.51
(8)	1-16-33	89	1.46048	38.04	224.45	4.41	87.22	28.86	2.18	23.72	.47	8.30	249.98	4.44
(9)	3-27-33	...	1.46061	38.44	223.96	....	86.84	28.44	2.32	24.56	.57	7.09	250.52	4.37
(10)	6- 5-33	86.5	1.46044	37.66	225.58	4.40	86.76	28.80	2.33	25.61	.63	5.24	248.74	4.68
(11)	8-14-33	86	1.46060	36.06	224.80	4.16	87.44	28.40	2.10	26.00	.65	4.96	249.58	....
						BUTTER 26								
(1)	9-14-31	...	1.46014	36.48	224.68	3.80	87.69	28.04	2.00	23.20	.50	4.37	249.71	....
(2)	11-23-31	90	1.46034	36.53	225.90	4.32	....	28.64	2.00	22.50	.49	7.52	248.36	7.58
(3)	2- 1-32	90	1.46020	37.82	226.04	4.24	88.12	28.34	2.46	24.95	.53	4.98	248.20	4.06
(4)	4-11-32	89	1.46042	37.98	224.38	4.40	86.80	28.00	1.71	23.38	.48	3.17	250.06	5.45
(5)	6-20-32	88.5	1.46008	37.32	224.45	4.21	86.44	28.68	1.83	25.02	.54	3.79	249.98	5.94
(6)	8-29-32	87.5	1.46042	37.33	223.94	4.26	84.62	28.12	2.07	23.42	.53	6.54	250.56	4.85
(7)	11- 7-32	89	1.46022	39.70	223.24	4.60	87.02	28.67	2.28	26.02	.60	7.90	251.34	4.69
(8)	1- 6-33	88.5	1.46052	38.01	223.04	4.07	86.96	28.94	1.86	25.11	.55	7.35	251.56	4.59
(9)	3-27-33	...	1.46036	38.36	224.20	3.92	87.13	28.78	2.28	24.65	.56	8.43	250.25	4.51
(10)	6- 5-33	86	1.46040	38.03	226.02	4.36	87.01	28.58	2.30	25.03	.68	4.49	248.24	4.85
(11)	8-14-33	86	1.46050	36.32	225.02	4.10	87.60	28.66	2.09	25.23	.66	4.32	249.34	....
						BUTTER 27								
(1)	9-14-31	...	1.46030	36.62	224.65	....	87.23	27.58	2.02	23.90	.51	3.63	249.74	....
(2)	11-23-31	88	1.46048	36.38	224.41	4.44	.....	28.42	1.94	22.45	.44	5.91	250.01	8.11
(3)	2- 1-32	88	1.46020	38.17	225.54	4.45	87.94	28.85	2.44	24.52	.52	2.29	248.74	....
(4)	4-11-32	86	1.46068	37.68	223.68	4.52	87.36	28.32	1.81	22.49	.50	4.48	250.84	5.87
(5)	6-20-32	86	1.46044	37.22	223.40	4.12	87.06	27.96	1.72	24.40	.54	3.16	251.16	7.03
(6)	8-29-32	86	1.45972	37.30	224.08	4.12	85.98	28.20	2.13	24.92	.54	4.32	250.40	5.00
(7)	11- 7-32	86	1.46025	39.22	223.16	4.60	87.68	28.48	2.10	25.81	.62	6.73	251.43	4.92
(8)	1- 6-33	86	1.46058	37.93	223.19	4.32	87.25	28.46	2.06	25.64	.60	7.42	251.40	4.83
(9)	3-27-33	...	1.46071	38.24	223.70	4.06	86.87	28.31	1.94	23.97	.58	6.01	250.82	4.73
(10)	6- 5-33	84	1.46048	38.24	225.17	4.33	86.68	28.39	2.42	24.75	.70	4.28	249.18	4.85
(11)	8-14-33	84	1.46036	36.20	223.57	4.08	87.51	28.40	2.13	25.12	.62	4.88	250.96	....

TABLE 3B.—OXIDATION DATA—*Continued*
(Butters 22 to 27)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 22							
(1)	638	...	...	...	...	...	...	...	...	...	...	1280	12650	1742
(2)	891	926	959	1013	1069	1144	1269	1341	1430	1541	1712	1866	13310	2939
(3)	867	906	947	1020	1087	1156	1235	1338	1423	1545	1737	2065	13200	3163
(4)	327	582	733	853	917	980	1052	1126	1209	1299	1397	1532	12210	1905
(5)	225	373	506	703	814	...	...	...	...	...	...	...	3300	814
(6)	276	808	929	1027	1104	1199	1341	...	1513	1701	2046	2643	11220	2749
(7)	229	364	491	824	989	1053	...	...	...	...	...	...	4950	1096
(8)	258	317	344	481	557	645	781	930	1387	2140	...	...	8910	2240
(9)	499	651	738	963	1169	1277	1334	1405	1525	1589	1693	1825	13530	2388
(10)	912	935	960	1039	1105	1155	1254	1336	...	...	...	...	6930	1462
(11)	839	886	928	1039	1127	1374	...	...	...	...	...	...	5390	3828
							BUTTER 23							
(1)	471	501	536	599	651	700	748	828	898	971	1063	1186	12210	1346
(2)	695	821	864	930	978	1049	1119	1175	1278	1339	1424	1567	15840	2878
(3)	544	570	599	687	759	854	971	1112	1369	1949	...	...	9680	2480
(4)	463	590	721	883	1016	1245	1614	2136	2659	3013	3748	4261	11000	4261
(5)	283	333	388	465	566	649	722	826	948	1088	1303	...	10780	1490
(6)	589	701	758	850	966	1081	1198	1374	1537	1780	2148	2538	11660	2786
(7)	328	424	487	609	676	739	793	871	1025	1100	1162	1245	13640	1473
(8)	512	574	632	796	889	1020	...	...	...	...	2467	...	9900	2467
(9)	685	733	772	989	1096	...	...	...	...	...	...	...	8470	3864
(10)	225	385	529	771	930	1007	1150	1385	1529	1744	2276	...	10230	2385
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(12)	680	701	738	808	878	955	1058	...	...	...	...	...	6490	1808
							BUTTER 24							
(1)	309	432	465	537	595	657	716	789	857	933	1030	1164	12210	1371
(2)	349	422	469	574	679	853	1128	1346	...	...	...	...	7260	1628
(3)	422	444	475	534	624	697	810	905	1052	1154	1272	1422	14850	2828
(4)	687	750	800	913	1078	1175	1304	1433	1573	1848	2123	2542	11990	3051
(5)	214	254	292	363	441	519	575	661	750	830	...	...	10780	1191
(6)	300	361	407	475	557	656	760	880	1006	1162	1388	1648	13310	2750
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	321	665	737	800	1004	1060	...	...	1447	1570	1745	2445	11000	2445
(9)	469	491	525	708	783	841	934	1030	1664	2622	2848	...	12320	5000
(10)	385	455	475	581	661	741	855	1021	...	...	...	...	8350	1651
(11)	493	550	625	1031	...	...	...	...	...	...	...	...	3630	2758
							BUTTER 25							
(1)	588	627	658	742	795	857	921	994	1069	1156	1228	1322	12210	1613
(2)	319	410	491	770	1038	1379	...	...	...	...	...	...	4620	1563
(3)	142	389	416	643	713	763	814	862	912	965	1022	1088	15180	1889
(4)	552	631	689	773	857	955	1063	1297	2188	...	...	...	7700	2188
(5)	353	401	445	517	568	624	674	713	787	855	914	970	14190	1286
(6)	546	696	804	895	968	1038	1121	1239	1357	1645	2014	...	10340	2168
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	393	418	445	623	754	1030	...	...	...	...	...	...	13860	3918
(9)	593	617	647	700	758	811	866	934	1003	1081	1172	...	10780	1270
(10)	889	968	1022	1089	...	...	...	...	...	...	...	...	13420	3758
(11)	639	718	763	837	911	1001	1198	2450	...	...	...	...	6600	2450
							BUTTER 26							
(1)	519	564	588	651	713	756	816	861	927	1021	1097	1268	11550	1410
(2)	479	515	547	615	669	739	804	872	946	1065	1165	1434	12100	2564
(3)	513	561	594	658	813	971	1079	1200	1290	1352	1438	1624	17710	3094
(4)	312	365	417	494	567	647	774	1002	1462	1920	2574	...	10120	2773
(5)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(6)	452	548	593	667	740	813	886	977	1086	1222	1419	1866	12430	2708
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	471	...	...	...	...	...	...	1176	...	...	...	...	10670	2581
(9)	529	552	593	681	771	860	967	1662	2389	...	...	...	7810	2474
(10)	807	866	1085	1158	1433	1860	2374	...	...	...	...	...	5830	2509
(11)	208	385	413	465	525	582	650	717	860	...	...	...	8140	970
							BUTTER 27							
(1)	347	447	621	775	857	903	984	1051	1129	1225	...	...	10230	1355
(2)	181	259	346	418	479	527	584	642	728	798	875	960	15400	1449
(3)	391	457	489	545	594	644	708	782	868	968	1109	1320	15180	2447
(4)	539	599	653	802	965	1151	1531	1890	2307	...	...	...	8580	2791
(5)	276	307	346	417	487	573	672	752	870	1097	1512	...	9900	1512
(6)	468	733	792	905	1029	1153	1311	1519	1757	2017	2357	...	10780	2773
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	556	645	757	874	967	1061	1174	1353	1614	1833	...	...	9790	2236
(9)	523	558	582	639	703	779	839	916	1003	1067	1235	1479	12540	2680
(10)	642	674	709	775	859	1086	...	...	...	...	...	...	5060	1213
(11)	420	445	477	540	612	696	857	1107	...	...	...	...	9130	2340

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Continued*
(Butters 28 to 32)

	Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
							BUTTER 28							
(1)	9–14–31	...	1.46034	36.17	224.65	3.68	87.11	27.57	1.82	20.68	.51	4.29	249.74	7.10
(2)	11–30–31	87.5	1.46063	35.54	223.87	3.90	86.00	27.60	2.13	21.68	.54	6.19	250.62	5.82
(3)	2–15–32	...	1.46012	37.75	222.94	3.35	86.62	28.90	2.58	26.15	.60	8.66	251.66	6.42
(4)	4–18–32	88	1.46036	37.36	223.14	4.16	88.10	28.24	1.75	23.94	.61	5.77	251.45	5.59
(5)	6–27–32	87	1.46040	38.18	224.66	4.09	85.73	28.10	1.52	24.82	.59	4.05	249.74	6.13
(6)	9– 5–32	86	1.46048	37.19	225.14	3.78	88.34	28.32	2.39	24.76	.60	3.09	249.20	5.14
(7)	11–14–32	86	1.46016	38.66	224.20	4.42	86.76	28.38	2.03	24.62	.70	7.33	250.26	4.93
(8)	1–23–33	85.5	1.46027	39.12	223.60	4.48	88.02	28.57	2.24	24.66	.67	7.20	250.94	4.85
(9)	4– 3–33	84.5	1.46070	38.22	223.58	4.52	86.30	28.13	2.32	24.10	.66	4.54	250.96	....
(10)	6–12–33	85	1.46023	37.66	224.51	3.56	85.06	28.56	2.34	24.23	.73	4.32	249.92	4.76
							BUTTER 29							
(1)	9–14–31	...	1.46030	36.30	223.30	3.62	87.10	27.41	2.01	20.44	.44	4.71	251.40	8.12
(2)	11–30–31	88.5	1.46037	34.96	224.26	4.02	86.70	27.71	2.02	20.55	.38	3.85	250.22	6.76
(3)	2–15–32	...	1.46011	38.03	223.11	3.44	86.30	28.30	3.10	25.90	.41	7.42	251.47	6.30
(4)	4–18–32	88	1.46028	37.69	223.40	4.30	87.73	28.44	1.86	23.92	.43	4.61	251.15	6.44
(5)	6–27–32	87	1.46058	38.34	223.60	4.22	86.28	27.90	1.62	24.64	.42	3.18	250.94	6.74
(6)	9– 5–32	86	1.46065	37.22	224.48	3.86	88.12	27.77	2.32	24.54	.43	3.05	249.94	4.97
(7)	11–14–32	86	1.46018	39.00	223.83	4.31	87.44	28.52	1.83	25.62	.51	5.50	250.67	5.07
(8)	1–23–33	85.5	1.46038	39.65	222.26	4.58	87.17	28.59	1.84	24.76	.44	7.69	252.44	4.97
(9)	4– 3–33	84.5	1.46059	38.62	223.08	4.36	86.10	27.84	2.06	24.63	.48	5.16	251.52	....
(10)	6–12–33	85	1.46041	37.55	224.16	3.64	85.55	28.62	2.21	24.95	.54	9.13	250.30	4.83
(11)	8–21–33	85	1.46048	38.64	224.28	3.74	86.88	28.20	2.16	25.00	.47	5.52	250.16	....
							BUTTER 30							
(1)	9–14–31	...	1.46034	36.51	224.08	3.40	87.36	27.32	1.90	21.22	.43	4.30	250.38	8.89
(2)	11–30–31	88	1.46061	35.28	224.06	4.15	84.74	27.30	2.06	21.82	.43	3.94	250.40	6.24
(3)	2–15–32	...	1.46032	38.22	223.38	3.52	86.37	28.02	2.58	26.07	.48	7.38	251.16	5.91
(4)	4–18–32	88	1.46050	37.54	223.25	4.32	87.72	28.37	1.95	23.64	.46	3.27	251.32	6.78
(5)	6–27–32	87	1.46040	38.09	224.47	4.28	85.90	28.16	1.94	24.85	.44	3.29	249.96	6.52
(6)	9– 5–32	86	1.46042	36.76	224.32	3.57	88.36	27.67	2.36	24.95	.45	3.68	250.12	5.08
(7)	11–14–32	86	1.46011	38.87	223.99	4.30	87.60	28.48	1.88	25.00	.50	7.08	250.50	5.14
(8)	1–23–33	85.5	1.46016	38.94	223.89	4.62	87.20	28.50	2.14	24.50	.46	6.24	250.60	5.03
(9)	4– 3–33	85	1.46068	38.24	222.98	4.73	87.24	28.72	2.08	25.62	.49	7.27	251.63	....
(10)	6–12–33	85	1.46016	37.42	224.19	3.64	84.14	28.37	2.16	24.84	.55	8.75	250.26	4.95
(11)	8–21–33	85	1.46041	38.70	224.22	4.00	87.04	28.33	1.94	25.20	.46	5.41	250.22	....
							BUTTER 31							
(1)	12– 7–31	93.5	1.45992	31.66	229.97	4.46	83.58	30.70	2.10	24.70	.49	2.17	243.96	6.96
(2)	2–15–32	...	1.45948	33.34	229.04	4.02	85.90	30.71	2.42	26.32	.54	4.32	245.44	7.06
(3)	4–25–32	93	1.45970	33.22	228.44	4.36	85.99	31.04	2.20	26.52	.56	3.73	245.60	6.06
(4)	7– 6–32	91	1.45960	33.42	223.72	4.60	85.92	30.62	2.08	27.20	.55	6.82	250.80	....
(5)	9–14–32	89	1.45941	33.32	228.24	3.94	87.45	30.58	2.91	27.37	.57	3.17	245.84	4.80
(6)	11–21–32	90	1.45969	33.79	227.20	4.72	85.54	30.70	2.63	26.89	.57	7.30	246.94	4.71
(7)	1–30–33	91	1.45972	33.98	230.37	5.02	87.08	31.02	2.67	26.53	.58	7.97	243.56	4.92
(8)	4–10–33	91	1.45949	33.53	227.50	5.18	86.06	30.42	2.23	26.49	.56	7.18	246.63	5.65
(9)	6–19–33	91	1.45950	33.61	229.77	4.80	87.23	30.68	2.52	26.30	.65	9.24	244.19	5.17
(10)	8–28–33	90.5	1.45951	33.40	230.52	4.68	86.80	29.77	....	.....	.61	4.59	243.40	....
(11)	11– 6–33	88.5	1.45953	33.50	228.27	4.21	86.06	31.22	3.18	28.56	.67	2.84	245.80	5.03
							BUTTER 32							
(1)	12– 7–31	94	1.45908	30.24	230.77	4.50	85.68	30.68	2.85	22.08	.19	3.42	243.12	7.13
(2)	2–15–32	...	1.45901	31.40	229.78	4.80	86.00	30.55	2.24	26.94	.23	6.47	244.90	7.17
(3)	4–25–32	93.5	1.45934	31.23	228.76	4.72	86.36	30.90	2.45	26.59	.34	4.38	245.28	6.25
(4)	7– 6–32	91.5	1.45959	31.38	230.53	4.53	85.29	31.43	2.54	27.64	.20	3.54	243.39	....
(5)	9–12–32	90.5	1.45954	31.18	230.82	4.74	87.28	30.92	3.20	27.42	.25	4.99	243.08	4.91
(6)	11–21–32	90.5	1.45929	31.82	228.34	4.58	85.20	31.37	2.65	26.78	.22	8.52	245.73	4.80
(7)	1–30–33	91	1.45932	31.82	231.46	5.10	86.44	31.71	2.98	27.55	.22	5.32	242.42	4.81
(8)	4–10–33	91	1.45922	31.38	229.52	5.28	87.04	31.26	2.50	26.32	.22	7.08	244.45	5.48
(9)	6–19–33	91	1.45911	31.64	230.43	4.52	86.98	31.20	2.86	27.68	.28	7.21	243.50	5.22
(10)	8–28–33	89.5	1.45912	31.42	230.38	4.88	86.92	30.24	....	.....	.32	4.62	243.54	....
(11)	11– 6–33	89	1.45923	31.00	228.02	4.08	85.56	30.99	3.27	28.60	.31	5.57	246.07	5.14
(12)	1–22–34	88.5	.....	31.50	227.66	4.09	85.95	30.72	3.30	28.68	.32	4.31	246.44	5.09

TABLE 3B.—OXIDATION DATA—*Continued*
(Butters 28 to 32)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 28							
(1)	472	518	567	666	729	816	908	981	1046	1117	1194	...	10670	1703
(2)	203	329	438	637	695	750	804	872	963	...	...	...	12100	1491
(3)	98	162	217	329	433	529	644	824	1135	...	...	...	8250	2159
(4)	459	533	578	682	865	1009	1172	1386	1679	2232	...	...	9350	2885
(5)	364	398	437	521	618	724	862	1104	...	...	...	...	7370	1330
(6)	575	682	738	832	942	1072	1255	...	...	...	...	...	5830	1294
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	308	...	...	...	...	...	...	...	1196	...	...	...	11880	2994
(9)	435	471	495	564	618	672	750	809	901	989	1091	1200	12320	1612
(10)	624	653	709	784	865	974	1076	1183	...	...	...	...	6710	1206
							BUTTER 29							
(1)	513	550	589	667	742	816	885	1002	1142	...	...	...	8580	1340
(2)	...	350	452	651	885	982	1079	1174	1300	1420	1523	...	15180	2562
(3)	398	695	746	825	898	985	1067	1185	1308	1464	1705	2076	12870	3474
(4)	476	556	622	751	905	1101	1365	1789	...	...	...	...	7150	2123
(5)	338	401	425	485	542	588	644	721	808	909	1015	1197	11440	1294
(6)	453	646	707	799	868	932	1000	1083	1181	...	...	...	8360	1248
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	437	...	...	...	...	803	946	1134	1457	1673	1960	2250	11770	2407
(9)	283	485	520	579	629	681	734	799	878	961	1049	1147	13200	1436
(10)	604	626	671	747	861	949	1040	1127	...	...	...	...	7370	1193
(11)	407	448	482	544	595	664	723	792	858	958	...	...	9680	1142
							BUTTER 30							
(1)	523	558	592	686	740	799	877	972	1062	1209	1430	...	10450	1636
(2)	547	587	620	675	753	807	882	956	1046	1144	1256	...	10890	1629
(3)	555	681	752	830	902	957	1019	1086	1228	...	...	...	7920	1260
(4)	587	1233	1313	1791	2278	2796	3192	...	...	...	...	...	5830	3371
(5)	320	501	600	682	764	853	1001	1122	1375	...	...	...	7810	1385
(6)	591	766	814	918	1008	1120	1253	1483	...	...	...	...	6600	1483
(7)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(8)	291	328	365	...	...	...	...	...	...	...	...	1274	11000	1274
(9)	749	784	805	866	958	1022	1123	1199	1321	...	...	...	10010	2450
(10)	655	703	723	796	870	944	1032	1155	1306	...	...	...	8360	1524
(11)	923	1075	1136	1406	1843	2374	...	...	...	...	...	...	4510	2435
							BUTTER 31							
(1)	492	531	572	638	697	748	814	869	951	1088	1432	1892	14410	3991
(2)	506	575	631	733	814	888	980	1130	1271	1605	...	...	8910	1645
(3)	860	954	1013	1148	1212	1318	1469	1645	1832	2214	2489	...	10780	3462
(4)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(5)	522	651	728	819	898	976	1056	1162	1250	1508	1702	1861	14080	2642
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	447	946	1020	1107	1176	1242	1312	1402	1499	1593	1718	1854	12210	2525
(8)	945	992	1021	1090	1176	1270	1367	1477	...	...	...	...	8360	2708
(9)	942	1395	1439	1584	1756	1885	2015	2161	2300	2423	...	...	9350	2461
(10)	730	761	795	850	924	991	1060	1149	1337	...	...	...	8030	1432
(11)	717	958	1042	1108	1171	1230	1293	1371	1469	1619	2234	...	10010	2296
							BUTTER 32							
(1)	589	633	668	730	799	883	969	1081	1193	1331	1472	1616	12540	1911
(2)	213	303	357	459	549	642	738	852	1022	1189	1414	1712	12650	2570
(3)	595	920	1052	1274	1442	1588	1893	2347	2732	3404	...	...	9680	3737
(4)	351	437	466	534	588	625	679	736	792	867	942	1040	12650	1754
(5)	489	555	608	688	751	828	901	985	1063	1150	1248	1358	17600	3407
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	565	832	928	1072	1179	1277	1420	1532	1738	1945	2273	2644	11000	2644
(8)	1005	1062	1118	1228	...	...	...	...	...	2728	...	...	9460	2849
(9)	....	...	...	...	...	...	...	...	...	...	...	...	....	....
(10)	1935	...	...	...	...	...	...	...	...	...	...	...	8140	3870
(11)	575	623	661	749	830	922	1024	1133	1249	1369	...	...	8800	1369
(12)	...	...	...	...	...	...	...	...	...	...	...	...	....	....

TABLE 3A.—PHYSICAL AND CHEMICAL CONSTANTS—*Concluded*
(Butters 33 to 36)

Date	Score	Index of refraction	Iodin No.	Sapon. No.	Sol. acids	Insol. acids	R.-M. No.	Pol. No.	J.-K. No.	Free fatty acids	Acetyl value	Mean molecular weight of fat	pH
BUTTER 33													
(1) 12- 7-31	93.5	1.45924	32.66	229.77	4.30	85.40	26.80	2.95	21.69	.59	2.86	244.18	7.11
(2) 2-15-32	...	1.45974	33.42	228.64	4.66	86.03	30.24	2.21	26.57	.63	5.78	245.39	7.13
(3) 4-25-32	93	1.45960	33.42	227.88	4.46	86.54	30.23	2.48	25.80	.65	4.95	246.22	6.28
(4) 7- 6-32	91.5	1.45944	33.75	229.66	4.64	84.84	30.52	2.45	27.21	.62	3.79	244.32	....
(5) 9-12-32	91	1.45952	33.59	229.95	4.61	87.08	30.05	3.29	27.27	.66	3.35	244.00	4.97
(6) 11-21-32	91	1.45905	34.01	227.74	4.72	85.28	30.36	2.85	26.06	.65	7.40	246.37	4.85
(7) 1-30-33	91	1.45966	34.15	229.33	5.20	86.77	30.68	2.52	26.68	.65	5.18	244.66	4.97
(8) 4-10-33	91	1.45966	34.08	228.77	5.00	86.38	30.76	2.60	26.42	.65	6.69	245.26	5.55
(9) 6-19-33	91	1.45961	33.16	229.82	4.88	87.30	30.06	2.88	26.23	.74	8.60	244.14	5.22
(10) 8-28-33	90	1.45962	33.75	230.00	4.82	87.44	29.53	....	.....	.70	5.50	243.94	....
(11) 11- 6-33	89	1.45971	33.52	228.34	3.84	85.06	30.46	3.30	28.08	.78	4.62	245.72	5.14
(12) 1-22-34	88.5	.....	33.28	228.26	3.84	85.39	30.42	3.30	28.24	.78	4.25	245.80	5.11
BUTTER 34													
(1) 12-17-31	88	1.45965	33.16	227.83	4.06	86.78	28.98	2.42	23.56	.44	9.47	246.26	6.76
(2) 2-22-32	89	1.46002	33.98	226.98	4.66	86.90	27.37	2.10	24.97	.41	5.21	247.18	....
(3) 5- 1-32	...	1.45958	33.32	223.75	4.32	86.32	28.68	2.38	24.72	.43	5.48	250.76	6.23
(4) 7-11-32	88.5	1.45975	33.60	225.44	4.36	85.10	28.52	2.42	25.46	...	....	248.88	....
(5) 9-19-32	86	1.45980	32.82	225.40	4.42	86.33	28.71	1.85	24.91	.42	5.90	248.92	5.31
(6) 11-28-32	86.5	1.45978	34.45	226.23	4.49	86.31	29.46	2.46	26.99	.42	4.29	248.02	5.08
(7) 2- 6-33	86	1.45978	33.68	226.35	4.30	86.39	29.34	2.65	25.84	.41	6.38	247.88	5.48
(8) 4-17-33	86	1.45976	33.93	226.74	4.63	.....	28.97	2.54	26.04	.41	8.08	247.45	5.62
(9) 6-26-33	86	1.45970	34.22	227.30	4.02	87.06	28.78	2.84	25.39	.49	7.19	246.84	....
(10) 9- 4-33	...	1.45971	33.90	227.14	4.56	87.50	29.50	2.76	25.85	.49	5.56	247.02	....
(11) 11-13-33	84	1.45979	34.80	225.72	5.06	87.58	29.88	2.76	26.42	.50	....	248.59	5.42
BUTTER 35													
(1) 12-17-31	90	1.45925	32.56	227.60	3.50	87.71	28.49	2.33	23.48	.84	3.43	246.51	6.11
(2) 2-22-32	90	1.45956	34.38	225.75	4.50	87.14	28.14	2.13	25.06	.89	5.07	248.52	....
(3) 5- 1-32	...	1.45973	33.68	225.19	4.49	86.98	28.40	2.41	24.71	...	5.89	249.16	6.03
(4) 7-11-32	89.5	1.45981	33.98	225.61	4.61	84.98	29.39	2.24	26.00	...	....	248.70	....
(5) 9-19-32	89	1.45975	32.86	225.76	4.13	87.52	27.46	2.22	24.80	.93	6.78	248.52	5.17
(6) 11-28-32	89	1.45978	34.38	225.74	4.52	86.26	28.98	2.34	26.22	.92	4.29	248.55	4.97
(7) 2- 6-33	88	1.45939	33.45	225.74	4.02	86.86	29.24	2.50	25.88	.96	5.92	248.55	5.19
(8) 4-17-33	88	1.45960	33.66	226.08	4.72	.....	28.76	2.30	25.24	.92	7.16	248.16	5.53
(9) 6-26-33	87	1.45974	33.68	226.96	3.74	87.14	29.16	2.71	25.65	1.07	6.12	247.22	....
(10) 9- 4-33	...	1.45976	33.67	227.36	4.52	87.29	29.17	2.73	26.28	1.00	4.39	246.78	....
(11) 11-13-33	86	1.45979	34.34	227.98	5.09	87.62	29.26	2.74	26.47	1.06	....	246.04	5.32
BUTTER 36													
(1) 12-17-31	89	1.45951	32.84	226.50	4.11	87.82	27.80	2.33	24.16	1.43	9.43	247.70	6.28
(2) 2-22-32	88.5	1.45985	34.26	225.19	4.54	87.08	27.58	2.28	24.60	1.46	5.35	249.14	....
(3) 5- 1-32	...	1.45973	33.12	225.17	4.46	86.72	27.74	2.16	24.43	1.47	6.40	249.16	5.84
(4) 7-11-32	87.5	1.45978	33.46	225.47	4.35	86.82	28.22	2.06	24.49	1.52	....	248.85	....
(5) 9-19-32	87	1.46008	33.20	224.96	4.20	87.54	27.38	1.84	24.83	1.54	7.00	249.41	5.19
(6) 11-28-32	86	1.45977	33.54	225.14	4.28	86.27	28.94	2.38	27.01	1.54	6.42	249.22	4.97
(7) 2- 6-33	86.5	1.45978	33.26	225.02	4.04	87.41	28.48	2.36	25.30	1.56	5.48	249.35	5.17
(8) 4-17-33	85.5	1.45957	33.49	225.57	4.60	.....	28.43	2.30	25.60	1.57	8.85	248.74	5.35
(9) 6-26-33	85	1.45991	33.71	226.26	3.91	87.62	28.78	2.52	25.32	1.73	4.25	247.98	....
(10) 9- 4-33	...	1.45974	33.18	226.68	4.52	87.44	28.67	2.28	26.23	1.69	3.83	247.52	....
(11) 11-13-33	85	1.45972	33.84	226.46	4.84	87.14	29.12	2.22	26.49	1.77	5.93	247.76	5.17

TABLE 3B.—OXIDATION DATA—*Concluded*
(Butters 33 to 36)

	Time in minutes (including induction period) to absorption of milliliters of oxygen indicated												Total ml. of O_2 absorbed	Time for total O_2 absorbed, minutes
	110	550	1100	2200	3300	4400	5500	6600	7700	8800	9900	11000		
							BUTTER 33							
(1)	...	...	...	...	...	...	...	...	1075	1187	1310	1435	12650	1889
(2)	366	495	557	673	...	...	...	...	...	...	...	...	2310	688
(3)	576	663	717	865	1005	1203	1550	...	...	...	...	...	7920	3852
(4)	266	368	404	454	491	531	582	628	681	738	798	860	13970	1135
(5)	517	749	914	1031	1130	1243	1362	1497	...	...	...	...	7480	1615
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	520	674	876	1132	1245	1337	1457	1563	2235	...	...	...	8690	2740
(8)	956	1010	1051	1122	1200	1249	1344	1456	1560	1709	1897	...	10780	2455
(9)	1656	1713	1764	1904	1992	2101	2170	2392	2725	...	...	...	8360	2923
(10)	627	662	697	770	846	924	1016	1089	1268	...	...	...	7810	1295
(11)	607	680	748	887	1023	1185	1323	1393	1554	...	...	...	7700	1554
(12)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
							BUTTER 34							
(1)	662	700	744	814	880	964	1055	1175	1301	...	...	...	8580	1479
(2)	252	336	415	492	557	616	682	740	795	872	960	1070	14520	1486
(3)	233	283	324	384	446	510	565	644	717	836	923	1033	12870	1462
(4)	355	398	453	545	642	743	883	1033	1245	1507	1863	...	10120	1983
(5)	291	596	677	772	859	943	1031	1131	1271	1487	1835	2249	11660	2538
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	462	556	608	720	822	907	1010	1086	1205	1375	...	...	9240	1478
(8)	697	723	816	930	1037	1145	1260	...	...	...	...	...	9900	2832
(9)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(10)	365	406	452	544	624	718	834	1000	...	...	...	...	6600	1000
(11)	1107	1167	1257	1421	1492	1545	1691	1934	2333	...	...	...	8360	2455
							BUTTER 35							
(1)	625	652	690	753	828	895	1012	1153	1433	2185	...	...	9570	2699
(2)	280	333	390	507	606	718	818	965	1127	1337	1597	1868	12650	2436
(3)	479	527	576	674	770	890	1057	1375	...	...	...	...	6820	1449
(4)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(5)	575	648	714	827	936	1059	1193	1409	1660	2005	2562	...	10010	2604
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	661	744	793	910	1002	1086	1175	1306	1461	...	...	...	8470	1721
(8)	715	978	...	...	...	...	...	...	...	...	...	...	550	978
(9)	571	612	667	742	857	977	1082	1222	1357	...	...	...	8250	1444
(10)	313	371	409	489	558	636	699	790	919	1105	...	...	9570	1259
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
							BUTTER 36							
(1)	183	218	256	339	399	480	601	721	836	1010	1396	...	9900	1396
(2)	196	250	297	387	477	577	693	827	971	1114	1366	1949	12540	2468
(3)	236	280	321	402	486	605	727	954	1192	1600	2770	...	10010	2868
(4)	274	342	391	504	634	870	1239	1441	1771	2277	...	...	9460	2674
(5)	314	383	480	623	785	993	1211	1346	1631	1957	2159	...	10890	2387
(6)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(7)	403	548	616	746	876	1000	1196	1533	2072	...	...	...	8360	2440
(8)	422	454	516	617	763	861	993	1173	1416	...	...	...	8910	1715
(9)	...	...	...	...	...	...	...	...	...	...	...	...	....	....
(10)	342	384	428	1302	...	2600	...	...	...	...	...	...	4510	2660
(11)	...	...	...	...	...	...	...	...	...	...	...	...	....	....

TABLE 4.—RATES OF OXYGEN ABSORPTION BY THE FATS OF THE THIRTY-SIX BUTTERS

Date of removal from storage	First 500 ml.		4000 ml.		From 500 to 4000 ml.		Total absorption		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
				BUTTER 1					
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
5-23-29.....	64	12.8	273	6.8	209	6.0	4 700	322	6.9
7- 5-29.....	61	12.2	268	6.7	207	5.9	5 600	413	7.4
8-15-29.....	58	11.6	207	5.2	149	4.3	6 500	349	6.2
9-26-29.....	48	9.6	217	5.4	169	4.8	4 400	235	5.3
12-19-29.....	41	8.2	222	5.6	181	5.2	6 200	371	6.0
3-13-30.....	75	15.0	342	8.6	267	7.6	4 100	350	8.5
				BUTTER 2					
6- 6-29.....	52	10.4	243	6.1	191	5.5	6 300	425	6.7
7-18-29.....	61	12.2	264	6.6	203	5.8	5 000	365	7.3
8-29-29.....	43	8.6	167	4.2	124	3.5	11 300	582	5.2
10-10-29.....	65	13.0	233	5.8	168	4.8	5 500	330	6.0
11-21-29.....	65	13.0	288	7.2	223	6.4	5 175	383	7.4
1- 2-30.....	80	16.0	322	8.0	242	6.9	5 450	475	8.7
3-27-30.....	50	10.0	206	5.2	156	4.5	8 300	487	5.9
5- 8-30.....	60	12.0	314	7.8	254	7.3	4 500	363	8.1
				BUTTER 3					
6-14-29.....	59	11.8	240	6.0	181	5.2	7 000	485	6.9
7-25-29.....	99	19.8	295	7.4	196	5.6	5 000	352	7.0
9- 5-29.....	28	5.6	189	4.7	161	4.6	8 600	555	6.5
1- 9-30.....	60	12.0	259	6.5	199	5.7	5 000	330	6.6
2-20-30.....	61	12.2	292	7.3	231	6.6	5 000	376	7.5
4- 3-30.....	62	12.4	260	6.5	198	5.7	4 400	297	6.8
5-15-30.....	56	11.2	277	6.9	221	6.3	4 500	321	7.1
6-26-30.....	29	5.8	211	5.3	182	5.2	4 850	365	7.5
				BUTTER 4					
6-21-29.....	33	6.6	152	3.8	119	3.4	6 400	342	5.3
8- 1-29.....	75	15.0	461	11.5	386	11.0	6 425	1 066	16.6
12- 4-29.....	60	12.0	268	6.7	208	5.9	4 500	296	6.6
1-16-30.....	59	11.8	224	5.6	165	4.7	11 400	771	6.8
2-27-30.....	53	10.6	214	5.4	161	4.6	10 100	708	7.0
5-22-30.....	18	3.6	182	4.6	164	4.7	8 000	400	5.0
				BUTTER 5					
6-25-29.....	52	10.4	208	5.2	156	4.5	17 500	2 233	12.8
8- 8-29.....	43	8.6	200	5.0	157	4.5	6 350	445	7.0
9-19-29.....	49	9.8	197	4.9	148	4.2	6 000	298	5.0
12-12-29.....	84	16.8	262	6.6	178	5.1	5 000	324	6.5
1-23-30.....	72	14.4	213	5.3	141	4.0	6 400	339	5.3
4-17-30.....	62	12.4	299	7.5	237	6.8	8 900	497	5.6
5-28-30.....	29	5.8	143	3.6	114	3.3	9 550	470	4.9
8-21-30.....	38	7.6	155	3.9	117	3.3	7 500	420	5.6
				BUTTER 6					
8-22-29.....	48	9.6	157	3.9	109	3.1	10 700	552	5.2
10- 3-29.....	38	7.6	180	4.5	142	4.1	8 000	478	6.0
3-20-30.....	69	13.8	250	6.2	181	5.2	4 650	291	6.3
8-28-30.....	57	11.4	164	4.1	117	3.3	6 600	307	4.7

Date of removal from storage	110 to 550 ml.		110 to 4400 ml.		550 to 4400 ml.		Total absorption minus 110 ml.		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
				BUTTER 7					
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
8- 3-31.....	31	7.0	277	6.6	246	6.4	9 020	973	10.8
10-12-31.....	30	6.8	177	4.1	147	3.8	12 760	1 110	8.7
12-21-31.....	37	8.4	241	5.6	204	5.3	10 450	961	9.2
3- 7-32.....	43	9.8	397	9.3	354	9.2	9 020	1 664	18.4
5- 9-32.....	42	9.5	316	7.4	274	7.1	7 700	1 080	14.0
7-18-32.....	40	9.1	402	9.4	362	9.4	11 880	2 563	21.6
9-26-32.....	102	23.2	324	7.6	222	5.8	11 880	1 530	12.9
2-13-33.....	53	12.0	481	11.2	428	11.1	6 930	1 258	18.2
4-24-33.....	29	6.6	695	16.2	666	17.3	9 570	2 029	21.2
7- 3-33.....	40	9.1	285	6.6	245	6.4	8 580	768	9.0
9-11-33.....	37	8.4	222	5.2	185	4.8	10 340	2 595	25.1

TABLE 4.—RATES OF OXYGEN ABSORPTION—*Continued*

Date of removal from storage	110 to 550 ml.		110 to 4400 ml.		550 to 4400 ml.		Total absorption minus 110 ml.		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
BUTTER 8									
10–12–31.....	27	6.1	213	5.0	186	4.8	10 670	857	8.0
12–21–31.....	49	11.1	256	6.0	207	5.4	12 430	1 715	13.8
3– 7–32.....	35	8.0	285	6.6	250	6.5	7 920	913	11.5
5– 9–32.....	59	13.4	435	10.1	376	9.8	6 270	1 157	18.5
7–11–32.....	46	10.5	232	5.4	188	4.9	12 870	2 393	18.6
9–26–32.....	34	7.7	306	7.1	272	7.1	9 790	2 633	26.9
2–13–33.....	73	16.6	397	9.3	324	8.4	8 470	2 195	25.9
4–24–33.....	103	23.4	444	10.3	341	8.9	8 030	2 495	31.1
7– 3–33.....	129	29.3	332	7.7	203	5.3	10 340	949	9.2
9–11–33.....	89	20.2	509	11.9	420	10.9	6 930	1 197	17.3
BUTTER 9									
10–12–31.....	30	6.8	234	5.5	204	5.3	10 340	1 056	10.2
12–21–31.....	36	8.2	214	5.0	178	4.6	15 070	1 134	7.5
3– 7–32.....	52	11.8	329	7.7	277	7.2	7 370	1 143	15.5
5– 9–32.....	49	11.1	350	8.2	301	7.8	8 140	2 253	27.7
9–26–32.....	58	13.2	270	6.3	212	5.5	10 120	1 318	13.0
2–13–33.....	46	10.5	575	13.4	529	13.7	8 470	2 376	28.1
4–24–33.....	20	4.5	312	7.3	292	7.6	8 910	972	10.9
7– 3–33.....	36	8.2	261	6.1	225	5.8	9 460	766	8.1
9–11–33.....	18	4.1	374	8.7	356	9.2	9 240	2 469	26.7
BUTTER 10									
8– 3–31.....	48	10.9	248	5.8	200	5.2	14 080	1 242	8.8
10–19–31.....	21	4.8	212	4.9	191	5.0	12 210	961	7.9
12–28–31.....	41	9.3	320	7.5	279	7.2	16 940	2 593	15.3
3– 7–32.....	58	13.1	299	7.0	241	6.3	8 360	800	9.6
5–16–32.....	48	10.9	353	8.2	305	7.9	6 490	1 111	17.1
7–25–32.....	50	11.4	355	8.3	305	7.9	13 640	2 393	17.5
10– 3–32.....	54	12.3	982	22.9	928	24.1	4 510	1 048	23.2
2–20–33.....	42	9.5	322	7.5	280	7.3	8 470	1 082	12.8
5– 1–33.....	313	71.1	644	15.0	331	8.6	11 220	1 749	15.6
7–10–33.....	23	5.2	204	4.8	181	4.7	10 120	1 106	10.9
9–18–33.....	21	4.8	389	9.1	368	9.6	9 240	3 983	43.1
BUTTER 11									
8– 3–31.....	70	15.9	370	8.6	300	7.8	5 280	756	14.3
10–19–31.....	29	6.6	195	4.5	166	4.3	13 090	1 032	7.9
12–28–31.....	40	9.1	242	5.6	202	5.2	15 070	1 521	10.1
3– 7–32.....	43	9.8	278	6.5	235	6.1	9 020	972	10.8
5–16–32.....	53	12.0	761	17.7	708	18.4	11 000	3 491	31.7
7–25–32.....	26	5.9	235	5.5	209	5.4	6 160	309	5.0
10– 3–32.....	58	13.2	527	12.3	469	12.2	7 260	1 250	17.0
2–20–33.....	34	7.7	254	5.9	220	5.7	10 780	1 045	9.7
7–10–33.....	56	12.7	550	12.8	494	12.8	10 230	2 297	22.5
9–18–33.....	17	3.9	683	15.9	666	17.3	5 720	1 015	17.7
BUTTER 12									
8– 3–31.....	15	3.4	205	4.8	190	4.9	13 420	1 160	8.6
10–19–31.....	26	5.9	207	4.8	181	4.7	13 970	1 051	7.5
12–28–31.....	40	9.1	350	8.2	310	8.1	9 240	1 148	12.4
3– 7–32.....	52	11.8	342	8.0	290	7.5	11 110	2 527	22.7
5–16–32.....	87	19.8	502	11.7	415	10.8	7 150	1 184	16.6
7–25–32.....	54	12.3	523	12.2	469	12.2	9 790	1 769	18.1
10– 3–32.....	22	5.0	192	4.5	170	4.4	14 190	1 453	10.2
2–20–33.....	34	7.7	254	5.9	220	5.7	10 780	1 045	9.7
5– 1–33.....	99	22.5	560	13.1	461	12.0	11 880	2 279	19.2
7–10–33.....	58	13.2	583	13.6	525	13.6	12 760	2 108	16.5
BUTTER 13									
8–17–31.....	30	6.8	209	4.9	179	4.6	18 150	1 620	8.9
10–25–31.....	67	15.2	743	17.3	676	17.6	15 620	2 281	14.6
1– 4–32.....	40	9.1	276	6.4	236	6.1	14 410	1 368	9.5
3–14–32.....	243	55.2	754	17.6	511	13.3	13 090	2 664	20.4
5–23–32.....	479	108.4	1 118	26.1	641	16.6	4 950	1 263	25.5
8– 1–32.....	41	9.3	279	6.5	238	6.2	10 010	844	8.4
10–10–32.....	224	50.9	616	14.4	392	10.2	9 460	2 263	23.9
12–19–32.....	44	10.0	311	7.2	267	6.9	10 890	1 672	15.4
2–27–33.....	40	9.1	498	11.6	458	11.9	7 810	1 695	21.7
5– 8–33.....	49	11.1	549	12.8	500	13.0	5 610	1 684	30.0
9–25–33.....	107	24.3	485	11.3	378	9.8	11 000	1 114	10.1

TABLE 4.—RATES OF OXYGEN ABSORPTION—*Continued*

Date of removal from storage	110 to 550 ml.		110 to 4400 ml.		550 to 4400 ml.		Total absorption minus 110 ml.		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
				BUTTER 14					
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
10–26–31.....	44	10.0	266	6.2	222	5.8	11 550	1 260	10.9
1– 4–32.....	47	10.7	452	10.5	405	10.5	13 090	2 945	22.5
3–14–32.....	71	16.1	601	14.0	530	13.8	6 600	1 178	17.8
8– 1–32.....	25	5.7	271	6.3	246	6.4	8 030	1 164	14.5
10–10–32.....	92	20.9	531	12.4	439	11.4	12 430	4 047	32.6
5– 8–33.....	32	7.3	308	7.2	276	7.2	10 450	2 593	24.8
7–17–33.....	32	7.3	841	19.6	809	21.0	9 130	3 657	40.1
				BUTTER 15					
1– 4–32.....	222	50.5	2 556	59.6	2 334	60.6	8 470	3 928	46.4
5–23–32.....	152	34.5	977	22.8	825	21.4	2 200	2 069	94.0
8– 1–32.....	396	90.0	2 587	60.3	2 191	56.9	9 240	2 478	26.8
5– 8–33.....	934	212.3	1 633	38.1	699	18.2	7 810	2 345	30.0
				BUTTER 16					
5–31–32.....	69	15.7	972	22.7	903	23.5	6 930	1 839	26.5
				BUTTER 17					
			No sample of No. 17 absorbed as much as 4400 ml. of oxygen						
				BUTTER 18					
3–21–32.....	82	18.6	1 844	43.0	1 762	45.8	4 950	2 200	44.4
				BUTTER 19					
8–27–31.....	92	20.9	426	9.9	334	8.7	12 100	1 017	8.4
11– 9–31.....	77	17.5	368	8.6	291	7.6	16 830	1 919	11.4
1–18–32.....	54	12.3	279	6.5	225	5.8	16 280	2 165	13.3
3–28–32.....	315	71.6	612	14.3	297	7.7	11 000	2 328	21.2
6– 6–32.....	16	3.6	173	4.0	157	4.1	13 310	1 230	9.2
3–13–33.....	45	10.2	346	8.1	301	7.8	7 590	1 018	13.4
10– 9–33.....	19	4.3	234	5.5	215	5.6	8 800	1 116	12.7
				BUTTER 20					
8–27–31.....	22	5.0	200	4.7	178	4.6	11 000	868	7.9
1–18–32.....	54	12.3	279	6.5	225	5.8	16 280	2 165	13.3
3–28–32.....	48	10.9	311	7.2	263	6.8	1140	1 133	13.9
8–15–32.....	179	40.7	437	10.2	258	6.7	10 450	1 003	9.6
3–13–33.....	79	18.0	408	9.5	329	8.5	9 460	1 784	18.9
5–22–33.....	95	21.6	638	14.9	543	14.1	4 950	716	14.5
				BUTTER 21					
8–27–31.....	238	54.1	500	11.7	262	6.8	12 870	1 352	10.5
1–18–32.....	50	11.4	402	9.4	352	9.1	7 590	1 141	15.0
3–28–32.....	79	18.0	410	9.6	331	8.6	8 470	2 334	27.6
6– 6–32.....	27	6.1	256	6.0	229	5.9	9 900	986	10.0
8–15–32.....	301	68.4	722	16.8	421	10.9	13 090	3 652	27.9
10–24–32.....	149	33.9	581	13.5	432	11.2	11 550	1 021	8.8
3–13–33.....	71	16.1	356	8.3	285	7.4	11 110	1 967	17.7
5–22–33.....	670	152.3	1 188	27.7	518	13.5	8 030	2 842	30.9
10– 9–33.....	35	8.0	274	6.4	239	6.2	6 930	684	9.9
				BUTTER 22					
11–16–31.....	35	8.0	253	5.9	218	5.7	13 200	2 048	15.5
2– 1–32.....	39	8.9	289	6.7	250	6.5	13 090	2 296	17.5
4– 4–32.....	255	58.0	653	15.2	398	10.3	12 100	1 578	13.0
8–22–32.....	532	120.9	923	21.5	391	10.2	11 110	2 473	22.3
10–31–32.....	135	30.7	824	19.2	689	17.9	4 840	867	17.9
1– 9–33.....	59	13.4	387	9.0	328	8.5	8 800	1 982	22.5
3–20–33.....	152	34.5	778	18.1	626	16.3	13 420	1 889	14.1
5–29–33.....	23	5.2	243	5.7	220	5.7	6 820	550	8.1
8– 7–33.....	47	10.7	535	12.5	488	12.7	5 280	2 989	56.6
				BUTTER 23					
8–27–31.....	30	6.8	229	5.3	199	5.2	12 100	875	7.2
11–16–31.....	126	28.6	354	8.3	228	5.9	15 730	2 183	13.9
2– 1–32.....	26	5.9	310	7.2	284	7.4	9 570	1 936	20.2
4– 4–32.....	127	28.9	782	18.2	655	17.0	10 890	1 798	16.5
6–13–32.....	50	11.4	366	8.5	316	8.2	10 670	1 207	11.3
8–22–32.....	112	25.5	492	11.5	380	9.9	11 550	2 197	19.0
10–31–32.....	96	21.8	411	9.6	315	8.2	13 530	1 145	8.5
1– 4–33.....	62	14.1	508	11.8	446	11.6	9 790	1 955	20.0
5–29–33.....	160	36.4	782	18.2	622	16.2	10 120	2 160	21.3
10–16–33.....	21	4.8	275	6.4	254	6.6	6 380	1 128	17.7

TABLE 4.—RATES OF OXYGEN ABSORPTION—*Continued*

Date of removal from storage	110 to 550 ml.		110 to 4400 ml.		550 to 4400 ml.		Total absorption minus 110 ml.		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
				BUTTER 24					
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
8-27-31.....	123	28.0	348	8.1	225	5.8	12 100	1 062	8.8
11-16-31.....	73	16.6	504	11.7	431	11.2	7 150	1 279	17.9
2- 1-32.....	22	5.0	275	6.4	253	6.6	14 740	2 406	16.3
4- 4-32.....	63	14.3	488	11.4	425	11.0	11 880	2 364	19.9
6-13-32.....	40	9.1	305	7.1	265	6.9	10 670	977	9.2
8-22-32.....	61	13.9	356	8.3	295	7.7	13 200	2 450	18.6
1- 9-33.....	344	78.2	739	17.2	395	10.3	10 890	2 124	19.5
3-20-33.....	22	5.0	372	8.7	350	9.1	12 210	4 531	37.1
5-29-33.....	70	15.9	356	8.3	286	7.4	8 240	1 266	15.4
				BUTTER 25					
9-14-31.....	39	8.9	269	6.3	230	6.0	12 100	1 025	8.5
11-23-31.....	91	20.7	1 060	24.7	969	25.1	4 510	1 244	27.6
2- 1-32.....	247	56.1	621	14.5	374	9.7	15 070	1 747	11.6
4-11-32.....	79	18.0	403	9.4	324	8.4	7 590	1 636	21.6
6-20-32.....	48	10.9	271	6.3	223	5.8	14 080	933	6.6
8-29-32.....	150	34.1	492	11.5	342	8.9	10 230	1 622	15.9
1-16-33.....	25	5.7	637	14.8	612	15.9	13 750	3 525	25.6
3-27-33.....	24	5.5	218	5.1	194	5.0	10 670	677	6.3
8-14-33.....	79	18.0	362	8.4	283	7.4	6 490	1 811	27.9
				BUTTER 26					
9-14-31.....	45	10.2	237	5.5	192	5.0	11 440	891	7.8
11-23-31.....	36	8.2	260	6.1	224	5.8	11 990	2 085	17.4
2- 1-32.....	48	10.9	458	10.7	410	10.6	17 600	2 581	14.7
4-11-32.....	53	12.0	335	7.8	282	7.3	10 010	2 461	24.6
8-29-32.....	96	21.8	361	8.4	265	6.9	12 320	2 256	18.3
3-27-33.....	23	5.2	331	7.7	308	8.0	7 200	1 945	27.0
6- 5-33.....	59	13.4	1 053	24.5	994	25.8	5 720	1 702	29.8
8-14-33.....	177	40.2	374	8.7	197	5.1	8 030	762	9.5
				BUTTER 27					
9-14-31.....	100	22.7	556	13.0	456	11.8	10 120	1 008	10.0
11-23-31.....	78	17.7	346	8.1	268	7.0	15 290	1 268	8.3
2- 1-32.....	66	15.0	253	5.9	187	4.9	15 070	2 056	13.6
4-11-32.....	60	13.6	612	14.3	552	14.3	8 470	2 252	26.6
6-20-32.....	31	7.0	297	6.9	266	6.9	9 790	1 236	12.6
8-29-32.....	265	60.2	685	16.0	420	10.9	10 670	2 305	21.6
1- 6-33.....	89	20.2	505	11.8	416	10.8	9 680	1 680	17.4
3-27-33.....	35	8.0	256	6.0	221	5.7	12 430	2 157	17.4
6- 5-33.....	32	7.3	444	10.3	412	10.7	4 950	571	11.5
8-14-33.....	25	5.7	276	6.4	251	6.5	9 020	1 920	21.3
				BUTTER 28					
9-14-31.....	46	10.5	344	8.0	298	7.7	10 560	1 231	11.7
11-30-31.....	126	28.6	547	12.8	421	10.9	11 990	1 288	10.7
2-15-32.....	64	14.5	431	10.0	367	9.5	8 140	2 071	25.4
4-18-32.....	74	16.8	550	12.8	476	12.4	9 240	2 426	26.3
6-27-32.....	34	7.7	360	8.4	326	8.5	7 260	966	13.3
9- 5-32.....	107	24.3	497	11.6	390	10.1	5 720	719	12.6
4- 3-33.....	36	8.2	237	5.5	201	5.2	12 210	1 177	9.6
6-12-33.....	29	6.6	350	8.2	321	8.3	6 600	582	8.8
				BUTTER 29					
9-14-31.....	37	8.4	303	7.1	266	6.9	8 470	827	9.8
2-15-32.....	297	67.5	587	13.7	290	7.5	12 760	3 076	24.1
4-18-32.....	80	18.2	625	14.6	545	14.2	7 040	1 647	23.4
6-27-32.....	63	14.3	250	5.8	187	4.9	11 330	956	8.4
9- 5-32.....	93	21.1	479	11.2	286	7.4	8 250	795	9.6
4- 3-33.....	202	45.9	398	9.3	196	5.1	13 090	1 153	8.8
6-12-33.....	22	5.0	345	8.0	323	8.4	7 260	589	8.1
8-21-33.....	41	9.3	257	6.0	216	5.6	9 570	735	7.7
				BUTTER 30					
9-14-31.....	35	8.0	276	6.4	241	6.3	10 340	1 113	10.8
11-31-31.....	40	9.1	260	6.1	220	5.7	10 780	1 042	9.7
2-15-32.....	126	28.6	402	9.4	276	7.2	7 810	705	9.0
4-18-32.....	646	146.8	2 209	51.5	1 563	40.6	5 720	2 784	48.7
6-27-32.....	181	41.1	533	12.4	352	9.1	7 700	1 065	13.8
9- 5-32.....	175	39.8	529	12.3	354	9.2	6 490	892	13.7
4- 3-33.....	35	8.0	273	6.4	238	6.2	9 900	1 701	17.2
6-12-33.....	48	10.9	289	6.7	241	6.3	8 250	869	10.5
8-21-33.....	152	34.5	1 451	33.8	1 299	33.7	4 400	1 512	34.4

TABLE 4.—RATES OF OXYGEN ABSORPTION—*Concluded*

Date of removal from storage	110 to 550 ml.		110 to 4400 ml.		550 to 4400 ml.		Total absorption minus 110 ml.		
	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Total time	Rate per 100 ml.	Volume	Time	Rate per 100 ml.
				BUTTER 31					
	min.	*min.*	*min.*	*min.*	*min.*	*min.*	*ml.*	*min.*	*min.*
12- 7-31.....	39	8.9	256	6.0	217	5.6	13 300	3 499	26.3
2-15-32.....	69	15.7	382	8.9	313	8.1	8 800	1 139	12.9
4-25-32.....	94	21.4	458	10.7	364	9.5	10 670	2 602	24.4
9-14-32.....	129	29.3	454	10.6	325	8.4	13 970	2 120	15.2
1-30-33.....	499	113.4	795	18.5	296	7.7	12 100	2 078	17.2
4-10-33.....	47	10.7	325	7.6	278	7.2	8 250	1 763	21.4
6-19-33.....	453	103.0	943	22.0	490	12.7	9 240	1 519	16.4
8-28-33.....	31	7.0	261	6.1	230	6.0	7 920	702	8.9
11- 6-33.....	241	54.8	513	12.0	272	7.1	9 900	1 579	15.9
				BUTTER 32					
12- 7-31.....	44	10.0	294	6.9	250	6.5	12 430	1 322	10.6
2-15-32.....	90	20.5	429	10.0	339	8.8	12 540	2 357	18.8
4-25-32.....	325	73.9	993	23.1	668	17.4	9 570	3 142	32.8
7- 6-32.....	86	19.5	274	6.4	188	4.9	12 540	1 403	11.2
9-12-32.....	66	15.0	339	7.9	273	7.1	17 590	2 918	16.6
1-30-33.....	267	60.7	712	16.6	445	11.6	10 890	2 079	19.1
11-16-33.....	48	10.9	347	8.1	299	7.8	8 690	794	9.1
				BUTTER 33					
4-25-32.....	87	19.8	627	14.6	540	14.0	7 810	3 276	41.9
7- 6-32.....	102	23.2	265	6.2	163	4.2	13 860	869	6.3
9-12-32.....	232	52.7	726	16.9	494	12.8	7 370	1 098	14.9
1-30-33.....	154	35.0	817	19.0	663	17.2	8 580	2 220	25.9
4-10-33.....	54	12.3	293	6.8	239	6.2	10 670	1 499	14.0
6-19-33.....	57	13.0	445	10.4	388	10.1	8 250	1 267	15.4
8-28-33.....	35	8.0	297	6.9	262	6.8	9 700	618	7.9
11- 6-33.....	73	16.6	578	13.5	505	13.1	7 590	947	12.5
				BUTTER 34					
12-17-31.....	38	8.6	302	7.0	264	6.9	8 470	817	9.6
2-22-32.....	84	19.1	364	8.5	280	7.3	14 410	1 234	8.6
5- 1-32.....	50	11.4	277	6.5	227	5.9	12 760	1 229	9.6
7-11-32.....	43	9.8	388	9.0	345	9.0	10 010	1 628	16.3
9-19-32.....	305	69.3	652	15.2	347	9.0	11 550	2 247	19.5
2- 6-33.....	94	21.4	445	10.4	351	9.1	9 130	1 018	11.2
4-17-33.....	26	5.9	448	10.4	422	11.0	9 790	2 135	21.8
9- 4-33.....	41	9.3	353	8.2	312	8.1	6 490	635	9.8
11-13-33.....	60	13.6	438	10.2	378	9.8	8 250	1 348	16.3
				BUTTER 35					
12-17-31.....	27	6.1	270	6.3	243	6.3	9 460	2 074	21.9
2-22-32.....	53	12.0	438	10.2	385	10.0	12 540	2 156	17.2
5- 1-32.....	48	10.9	411	9.6	363	9.4	6 710	970	14.5
9-19-32.....	73	16.6	484	11.3	411	10.7	9 900	2 029	20.5
2- 6-33.....	83	18.9	425	9.9	342	8.9	8 360	1 060	12.7
6-26-33.....	41	9.3	406	9.5	365	9.5	8 140	873	10.7
9- 4-33.....	58	13.2	323	7.5	265	6.9	9 460	946	10.0
				BUTTER 36					
12-17-31.....	35	8.0	297	6.9	262	6.8	9 790	1 213	12.4
2-22-32.....	54	12.3	381	8.9	327	8.5	12 430	2 272	18.3
5- 1-32.....	44	10.0	369	8.6	325	8.4	9 900	2 632	26.6
7-11-32.....	68	15.5	596	13.9	528	13.7	9 350	2 400	25.7
9-19-32.....	69	15.7	679	15.8	610	15.8	10 780	2 073	19.2
2- 6-33.....	145	33.0	597	13.9	452	11.7	8 250	2 037	24.7
4-17-33.....	32	7.3	439	10.2	407	10.6	8 800	1 293	14.7
9- 4-33.....	42	9.5	2 258	52.6	2 216	57.6	4 400	2 318	52.7

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